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THE SIPHONOPHORES.

I.—THE ANATOMY AND DEVELOPMENT OF AGALMA.

BY J. WALTER FEWKES.

THE tubular jelly fishes present very interesting conditions of life, and so little has been written about them, except in special scientific memoirs, that a popular account of the anatomy and embryology of a few typical forms may be interesting to those who have not access to the literature. The scientific name of these animals is Siphonophoræ; they are all marine and found in almost every latitude, although most abundant in tropical oceans.

The best known example of the Siphonophoræ is by no means the best adapted to give a general idea of the structure of the order. The most common representative in our waters is called by sailors the "Portuguese man-of-war." Its scientific name is *Physalia*, and figures of it appear in almost every text book on zoölogy. The animal, however, is badly chosen to represent the order, for it is widely different in structure from the other tubular jelly fishes, and not only does not have a tube-like body, the characteristic which has suggested the name of the order, but also its anatomy and development, as far as known, are both abnormal and present many difficulties to one who wishes a knowledge of those jelly fishes with which it has a kinship.

If one should be asked to choose the genus best calculated to give a good idea of a tubular jelly fish, I think he would find one of the Agalmidæ the best choice. Two genera belonging to this

family are found in our waters; these genera may be known as *Agalma*[1] and *Agalmopsis*.

A popular description of the latter of these animals was given by Mrs. Agassiz in the well-known "Seaside Studies in Natural History" under the name of *Nanomia*.[2]

The present article will be devoted to the anatomy of *Agalma*, as I consider it the most typical representative of the tubular jelly fishes which have a float. I hope to follow this paper with another on the embryology of the same genus. Both articles are outline sketches of the subjects of which they treat.

The word *Agalma* is of Greek derivation, and means simply an ornament. No doubt Eschscholtz, the pioneer in the study of jelly fishes had in mind an ornament for the neck when he gave this name to the animal. As it gracefully floats in the water with its long pendant tentacles hanging behind it, the likeness to a living necklace with rosy band and transparent beads is very great. It also resembles closely a long, transparent, crystalline prism through which passes a highly colored thread resembling a longitudinal axis, such as is often found in glass models of crystals used in the study of mineralogy.

It will be found immediately, if one tries to raise the *Agalma* out of the water by the hand, that the prism is not a simple crystalline body, but is formed of members which are joined together in such a fragile manner that an attempt of this kind detaches all the component parts, and the beautiful crystal falls back into its native element broken into a hundred fragments. The parts thus detached are commonly known as individuals, and the whole prism as a colony. The individuals or pieces which compose the colony are extremely transparent, so that one can with difficulty follow by means of the eye their bounding lines, and often times to convince himself where the outline is, the sense of touch must supplement that of sight; even then one only becomes conscious that he has touched the animal when it shrinks away from the finger or contracts itself as if alarmed.

[1] Our *Agalma*, which I think is the same as Sars' *Agalmopsis elegans*, was discovered by me while at work in the laboratory of Mr. Alex. Agassiz at Newport. My reasons for considering *Nanomia* a synonym of *Agalmopsis* and not *Halistemma* or *Stephanomia* were given in a paper published in the Bulletin of the Museum of Comparative Zoölogy at Cambridge.

[2] *Nanomia* was first described by Mr. Alexander Agassiz. Proc. Boston So. Nat. Hist., IX, p. 181, 1863. See also North American Acalephæ, p. 200.

To take the animal entire out of the water where it lives, it is

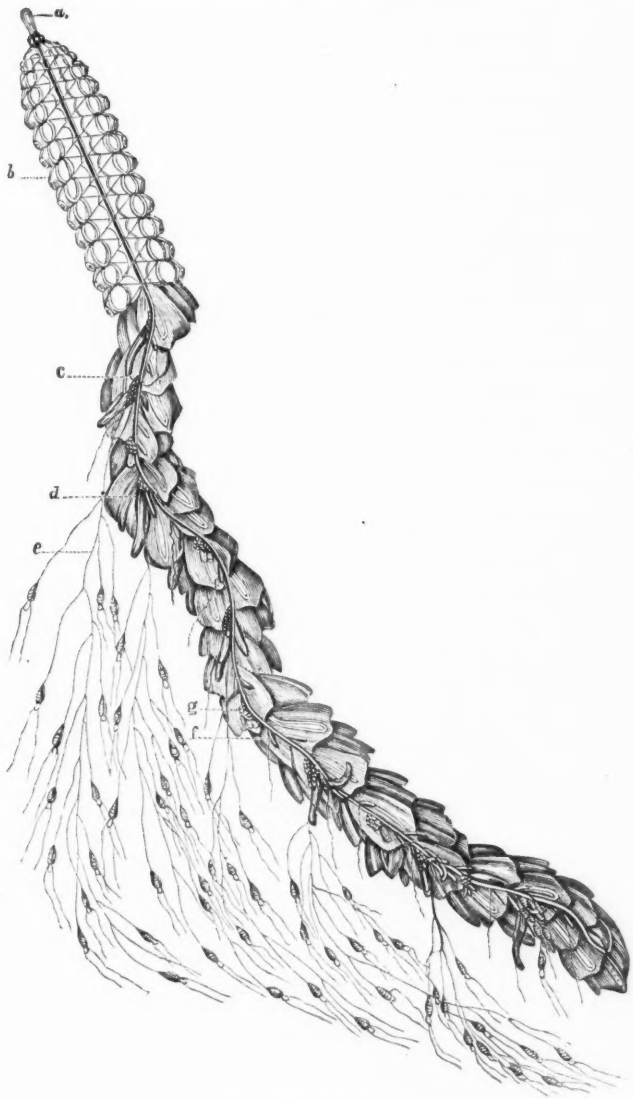

FIG. 1—*Agalma elegans.*

The lettering is explained in the following pages.

best to place under it a deep glass jar and then allow the water to flow gently into the vessel, floating with it the unconscious *Agalma*. Confined in a jar with the light thrown upon it at a proper angle, the animal may be studied at leisure through the sides of the glass. The observer must not forget that he can seldom keep these fragile jelly fishes alive, in confinement, longer than a few days. At first sight the multiplicity of parts in the *Agalma* gives us a rather confused idea of the structure of the several members which go to make up the colony. A more attentive study will reveal the fact that many of the component parts are frequently duplicated, and that five or six characteristic forms include those of all the appendages to an axis or stem which seems at times to give support to hundreds of differently shaped parts. Many of the appendages seem to be very different from these typical members, from the fact that they are in undeveloped stages of growth.

The general characters of the appendages I will consider in sequence after a mention of that part which connects all the different members, viz: the axis or stem.

The Axis or Stem.—A study of the anatomy of *Agalma* leads us naturally to begin with the rosy-colored axis. To this structure the order of Siphonophoræ, to which *Agalma* belongs, owes its name. Passing through the colony from one end to the other, it connects all the individual members both physiologically and anatomically. Physiologically in the sense that to some of these members falls the task of eating for the whole, to others the function of propulsion, while to a single individual is delegated the duty of floating the whole community.[1] If those individuals which serve the function of propulsion are detached, the colony has only passive means of locomotion. If the eating individuals are cut off, the colony dies for want of nourishment. New individuals, however, are continually being developed from buds, so that it seldom happens, even when the stem is deprived of its members, that the colony suffers any fatal consequences.

The length of the stem in larger specimens, when extended, is about four feet, yet the animal is often contracted to half that length. The diameter is about that of a knitting needle, and is nearly uniform; a slight increase may be detected at either end.

[1] That which supports the animal in the water, and which is called the float, is considered by many naturalists a distinct individual. I regard it an organ and not an individual. My reasons will be given when I consider the development of this structure.

The different appendages or members all arise from one side of this axis; this side has been called a ventral line. The fact that they appear to take their origin on all sides is brought about by a twisting of the stem itself There are two regions to be distinguished in the stem, which are known as the necto-stem and the polyp-stem. The former is known by appendages which act as means of propulsion, the latter by the polypites or feeding polyps. *Agalma* is said to be polymorphic because it bears on the stem individuals which assume different forms according to their functions. These individuals are as follows (Fig. 1, letters as below):

I. Appended to the necto-stem:
   a. The float.
   b. The necto-calyxes or swimming bells.

II. Appended to the polyp-stem:
   c. The covering scales or bracts.
   d. Polypites or feeding polyps, from which hang
   e. Tentacles and tentacular knobs.
   f. Tasters.
   g. Sexual bells of two kinds, male and female.

Those who believe with Leuckart that every bud on the animal is an individual, must regard the tentacular knobs also as separate individuals. The float, necto-calyx and covering scale are of jelly-like consistency, and are modified "medusa bells." The polypites and tasters are modified probosces, and the sexual bells are combinations of both. The last are the most perfect members of the whole colony. The tentacles are organs and not individuals, although so looked upon by many naturalists. The same remark also applies to the tentacular knobs. The first structure to be noticed is a little sac filled with air, which is called the float.

The Float.—The only appendage to the stem which is not duplicated except in monstrosities is the air-bladder or float. In *Agalma* it is very small and seems hardly large enough to buoy the animal up. It is supposed to keep the colony upright as it swims in the water. Many naturalists regard the float as the enlarged end of the axis in which, from its upper walls, hangs a sac filled with air. It is supposed by them that the extremity of the stem has been infolded like the finger of a glove when reversed, and that the edges of the stem at the position of infolding had approached so as to leave a small opening leading from the reëntering part into the surrounding water. This opening can

be seen in *Agalma*, but is not so well marked as in certain allied genera. Another suggestion for the homology of the float of *Agalma* is that it is a bud the same as certain of the other structures along the axis. This view was first published by Metschnikoff. I shall consider it at length when I speak of the development of this part.

The air sac in *Agalma* contains air or gas, and it opens into the cavity of the stem by an aperture opposite that into the surrounding water. The opening from the float into the water is surrounded by a sphincter muscle and dark crimson pigment spots of unknown function.

The Necto-calyxes.—The individual which performs the function of moving the colony through the water is called the necto-calyx or swimming bell. These are found occupying about one-third of the whole axis of the animal, and are arranged in two rows. They are transparent, bell-shaped and easily detached. Each row contains from ten to fifteen members. All the buds which later develop into necto-calyxes are grouped together in a botryoidal cluster just below the float. No necto-calyxes are developed from any part of the stem except this cluster of immature buds just under the float. The growth of an adult necto-calyx from a bud is very complicated, and there is no uniformity of opinion among naturalists as to its method.

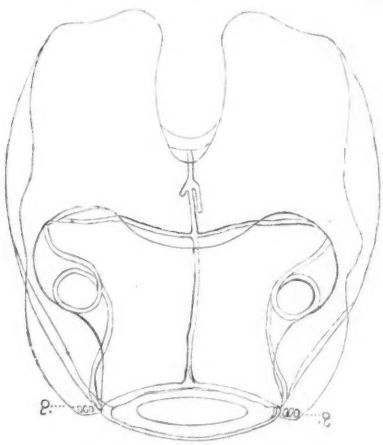

FIG. 2.—Necto-calyx.

A necto-calyx is simply the locomotive part of an ordinary hydroid Medusa. It is the bell, and the proboscis and tentacles are wanting, as would naturally be expected in consideration of their function.

Each necto-calyx is united to the stem at a point diametrically opposite the entrance into the cavity of the bell, and the approximating sides of consecutive necto-calyxes fit closely together.

Two opposite sides of the bell walls rise as horn-shaped projections which embrace the axis and fit closely into certain spaces left between similar projections on bells of the opposite series. By a dovetailed arrangement of this kind rigidity is given to both series, and loss of energy in muscular action reduced. The action of the bell is as follows: Water is taken into the cavity and by muscular contraction of the walls is violently returned through the opening by which it entered. The resistance which the water thus forced out encounters from the surrounding medium, determines the amount of motion given to the colony. The direction which the animal takes depends upon the angle which water passing out of the necto-calyx makes with the line of the axis. This final condition depends in turn upon the position of the mouth of the bell as referred to the stem, and is regulated by the animal. When, for instance, the openings of all the bells on one side are at right angles to the line of the stem, and water is forced through them, lateral motion is given to the animal. In such a case the muscular contraction of the walls of the bells in a series must be simultaneous. Solitary action of necto-calyxes at either end of the series would alter the inclination of the stem in the water. When the bell mouths point downwards, *i. e.*, towards the end of the axis opposite the float, resistance would be exerted at an angle less than a right angle, and as a consequence a motion in the direction of the axis is a result. Combinations in the action of different bells might be made to impart almost any motion to the colony. The motion in *Agalma* is seldom rapid but very graceful.

What has been said would seem to indicate the existence of a nervous system, but in *Agalma* no nervous elements have yet been made out satisfactorily. Pigment spots found on the rim of the necto-calyx may be regarded as organs of sense, but that they are such is only probable. *Agalma* is sensitive to the touch of the finger on almost any part of the body.

Nourishment is brought to a swimming bell by means of the stem, and is distributed in the bell by what are known as the chymiferous tubes. These are radially situated and are four in number, to which may be added a tube running around the rim of the bell, and a medially placed vessel which unites the radial system with the stem cavity.

In the earlier conditions of the necto-calyx the four radial tubes resemble each other very closely, and are straight vessels

passing from a common junction directly to a circular tube. In the fully grown bell, however, two of these tubes diametrically opposite differ considerably from the other pair, and take, in their course from common junction to the rim of the necto-calyx, a peculiar turn or twist which I have represented in my drawing. At their junction with the "circular tube" in the rim of the bell lie two or three large lasso or stinging cells, which do not appear in a corresponding position in the other tubes; these cells have been regarded by some naturalists as the remnants of tentacles which never are found fully developed on the necto-calyxes. The portions of the bell in which the tubes with an abnormal course lie, are the same which send out the projections embracing the axis, and interlocking in the dovetailed manner I have described above.

I should not regard even a popular account of the necto-calyx complete, if it did not include a mention of two tubes ending blindly in the substance of the bell; these arise from the medial tube connecting the radial system with the stem cavity, and are known as the "mantle vessels." They lie in the same plane as those two radial tubes which do not have any variation in their direct course to the circular vessel. One of these tubes may be the same as the tubular cavity of the covering scale. Many naturalists have supposed that the structure last mentioned corresponds with one of the radial tubes of a swimming bell. I think that homology not a good one, but I consider the cavity of the covering scale is homologous with one of the "mantle tubes."

The necto-calyxes never voluntarily separate from the stem, but when by any mishap they are broken off, they still retain power of motion and move aimlessly about in irregular circles, keeping up muscular action for a considerable time. Their independent life, however, is very short, for since they are separated from the axis no nourishment can be supplied them. They are locomotive in their function, but rely upon the fluid which circulates in the stem for their support. When such is not supplied them they die.

c. The Covering Scale.—All of the stem except that upon which the necto-calyxes are fastened, is protected, in *Agalma*, by structures known as covering scales or bracts. The German designation of these parts "*Deckstücke*," is used by some English and American naturalists. The covering scales are gelatinous,

resembling in that respect the necto-calyxes, and are so closely approximated, as to overlap each other and apparently to form a single unjointed prism. They have an irregular triangular outline, and a flat leaf-like shape. In *Agalma* they seem to serve simply the function of protecting the structure beneath them. They are traversed throughout by a medially placed canal or tube, which terminates blindly at the distal end, and opens at the other extremity into the cavity of the stem. The junction with the stem is by means of a pedicel, which is appended to one angle of the bract and has muscular fibers on its under side.

At the very tip of the covering scale there is a cluster of cells which have been supposed to indicate the homologies of the scale with a portion of the necto-calyx. These cells are looked upon as rudimentary tentacles, and are relatively much larger in the young scale than in the adult.

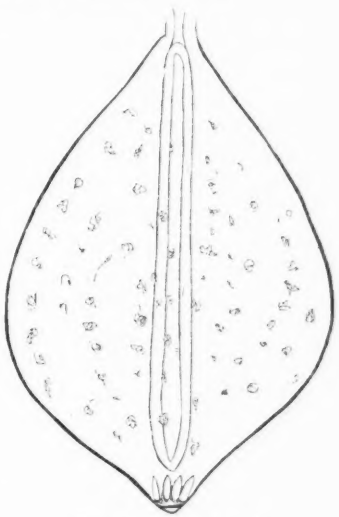

FIG. 3.—Covering scale.

Agalma has, in addition to those described, two kinds of covering scales, which are embryonic and provisional. These will be mentioned under the embryology, for they are confined to early stages in the development of the animal.

The feeding polyps which lie under the covering scales and which are protected by these modified medusa bells, next claim a description. They are known as the polypites.

d. Polypites.—Certain flask-shaped bodies, more highly colored than those yet described, are appended to the polyp-stem, and their distal extremities extend out between the covering scales. They are supposed to be stomachs and to eat for the whole colony. A mouth at one end takes the food, hepatic cells arranged in rows along the inside of the polyp assist to digest it, and after being digested the nutritive fluid is passed into the stem cavity through which it is distributed to every member of the community. From the base of the polypite on the upper side arise the tentacle

and tentacular knobs. The tentacle is jointed, very contractile, and histologically differs in no respect from the stem. Each tentacle can be drawn up to the base of its polypite, where it may be snugly packed away under a protecting scale, or it can be extended and allowed to project beyond the body of the *Agalma* to the distance of a foot or a foot and a-half. When thus extended the tentacular knobs are best seen and studied.

c. The Tentacular Knobs.—Each genus of the tubular jelly fishes seems to have a characteristic tentacular knob. *Agalma* is not an exception. Although in the adult appended to the tentacle, they begin their growth from the ciliated base of the polypite, and do not bud from the tentacle itself. New buds which are to develop into tentacular knobs, are continually forming on the feeding polyp, and as the tentacle grows are being continually pushed out on its walls. In the earliest history of the growth of the knob, even before the polypite on which it is borne is fully developed, we find it with others in a cluster, partially coiled up at the base of the polypite. At that time there is no tentacle, but simply a cluster of partially coiled undeveloped tentacular knobs. In such a condition they might easily be mistaken for a wholly different kind of knob from the adult, and the polyps to which they are joined might be looked upon as a different kind of polypite. I believe them only undeveloped forms of the true polypite with tentacular knobs.

Fig. 4.—Tentacular knob.

In general outline the adult tentacular knob preserves a likeness to a Medusa. One portion of it may be likened to a bell and another to a proboscis. The bell is represented by an envelope surrounding the knob, and we might find the homologue of the proboscis in the coiled structure within this envelope. The bell portion is called the involucrum; the coiled proboscis, the sacculus. The sacculus is of dark crimson color, and ends in two filaments, or threads, and a sac supposed to be contractile. The sac lies between the two filaments at their point of junction with the sacculus. It has been called a food reservoir, or "*Saft-behälter*." This last term has been also applied to other structures in the *Agalma*.

According to Keferstein and Ehlers, the tentacular knob of

Agalma is still more complicated. According to these naturalists there are two elastic bands or threads, which arise from the inside of the involucrum and are fastened to the extremity of the coiled sacculus. Their figures of a knob where the sacculus has been uncoiled, show these bands very plainly. When the sacculus is withdrawn into the involucrum it is wound around a style which passes directly from the fundus of the involucrum to the contractile sac. I have seen portions of the elastic bands, and figure them in my drawing. Provisional embryonic knobs exist in larval stages: they will be described later.

f. The Tasters.—The word taster,[1] by which organs now to be described have been designated by the Germans, is one of the best which has been suggested. The tasters have also been called "hydrocysts" and "*Saft-behältern.*" These bodies are easily to be mistaken for undeveloped feeding polyps, but a more intimate study of them shows the error of so doing. They differ from the adult polypite in that they have no mouth, are destitute of hepatic cells, and their tentacles have no tentacular knobs. They never, in *Agalma*, drop off, and it is extremely doubtful that they ever separate from the colony and form new communities similar to those from which they are themselves buds. Large lasso cells are sometimes found near their base, at the proximal end, one of which was erroneously mistaken for a float. Claus has made some very beautiful researches on the histology of the taster. I believe the taster is homologous to a polypite, and that its function has, in certain respects, changed its form.

FIG. 5.—Taster.

g. The Sexual Bells.—There remains yet to be mentioned the sexual members of the "colony." They assume the most perfect medusa form, and are found in clusters along the whole polyp stem. *Agalma* is monœcious; the male and female bells are separated from each other on the same stem, and arise on special pedicels from the axis. The female bells form botryoidal clusters and lie about midway between two polypites, but are never joined to the tasters as in some other genera. Each

[1] From "*tasten*," to touch.

female bell carries one egg, which will be described in the next article. Its growth and development will be found in the same place. The eggs are dropped in the water and there fertilized. Male and female bells ripen their products at different times. When the egg has left the animal, the sexual bell shrinks up on the stem and is finally absorbed or dropped; a scar on the stem alone tells of its former existence.

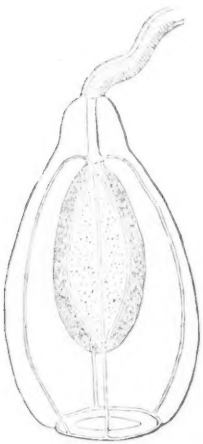

FIG. 6.—Male bell.

The male bells have more elongated pedicels than the female, but in both cases the sexual products are borne on the proboscis between the ectoderm, or superficial layers, and the endoderm. They probably originate from the intermediate layers, or mesoderm (?).

Agalma becomes sexually mature while yet retaining embryonic features. A young form of the most common species in the Mediterranean *(Agalma sarsii)* has been called another animal *(Agalma clavatum)*. It is, however, only an immature form arrived at sexual maturity. I believe *Nanonia cara* is the sexually mature young of the genus *Agalmopsis*. *Nanomia* was found at Newport and Nahant.

A few theoretical questions suggest themselves after this fragmentary account of the anatomy of *Agalma*. The first question which arises is, to what great groups in the animal kingdom is it allied? From the study of the anatomy naturalists were led to believe that *Agalma* was a free swimming hydroid. This theory was simultaneously and independently brought out twenty years ago by several naturalists. The Siphonophoræ were regarded as hydroids which instead of being fastened to the bottom of the ocean, were detached or free swimming, and the point of attachment of the fixed form was supposed to be represented in a float to support the animal in the water. Many bitter personalities, happily now forgotten, were indulged in by those who claimed to have originated the theory, and it was defended with great zeal by its advocates. Embryology teaches another answer to the question of what *Agalma* is, and it is my purpose to speak of that answer after a consideration of the development of the animal.

Another question no less significant than the first is, as to how we know that the different appendages along the axis are individuals and not organs. Why not look upon them simply as organs? To answer this question we get some light from a study of animals allied to *Agalma*. There are tubular jelly fishes in which the appendages to the stem are not so numerous as in *Agalma*, and where there are clusters of appendages at intervals along the stem. Each one of these clusters, however, is composed of all essential members to fit it to lead a separated existence. We have in each a necto-calyx, a covering scale, feeding polyps with tentacle, and sexual organs. These clusters are bound together by the stem, and at a certain age in the life of the colony the stem breaks midway between two clusters, which swim about as separated individuals which live long enough to change their general form. In these genera we certainly have a composite animal composed of smaller clusters, each one of which is a colony. In *Agalma* that fact is masked, since the different component parts are pressed so closely together on the axis, but it seems none the less certain that the *Agalma* is composite. If we take the different parts which compose one of these colonies, many of which joined together form the *Agalma*, we find a resemblance to a typical hydroid medusa in each of its component parts. In the necto-calyx we have a hydroid medusa where tentacles and proboscis are wanting; in the sexual bells we find the same likeness where bell and proboscis are present and tentacles fail. The covering scale, polypite and tentacle together make up another, and so on. All closely resemble a common type of hydroid medusa. Embryology will shed much light upon this question, which I shall again discuss.

From what the anatomy of *Agalma* teaches, we may conclude that we have in this animal the following polymorphic individuals whose homologous parts "*inter se*" and with a common *Lizzia* are given below:

Lizzia,	Bell.	Tubes of the bell.	Proboscis.	Tentacles.	
Agalma,					
1st individual,	Float.	———	Stem.	———	
2d "	Necto-calyx.	Present.	——— ———	——repres'd by lasso cells	(*b.*)
3d "	Covering scale.	Cavity of scale.	Polypite.	Tentacles.	(*c.d.*) (*e.*)
4th "	Covering scale.	Cavity of scale.	Taster.	Thread-like tentacles	(*e.f.*) (*e.*)
5th "	Bell.	Present.	Proboscis with ova.	———	(*g.*)
6th "	Bell.	Present.	Proboscis with sperm.	———	(*g.*)
Doubtfully I add to those given					
7th individual,	Involucrum.	———	Sacculus.	———	

The first individual is never duplicated; the remaining are

numerous along the stem. A dash shows that the organs of the typical medusa are wanting.

It will be seen that I do not homologize the stem of *Agalma* with the stem of a fixed hydroid, but with the proboscis of a medusa. The Siphonophoræ are not free swimming hydroids, but medusæ with polymorphic individuals budding from it similarly to the condition in *Lizzia*. These buds are not zoöids but physiological and morphological individuals. I cannot follow Leuckart when he considers, however, that every bud is an individual. Three buds, the scale, the polypite and the tentacle together make one individual. Upon this subject we must look to embryology for light.

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DESTRUCTION OF OBNOXIOUS INSECTS BY MEANS OF FUNGOID GROWTHS.

BY PROF. A. N. PRENTISS.

[*Concluded.*]

Experiment No. 3.—May 10.—A calla lily has become infested with aphides and red spider. The whole plant is carefully washed with a sponge except a small spot on one leaf where twenty-seven aphides are left, and a similar spot on another leaf where about twenty red spiders are left. The whole plant is sprinkled with domestic yeast, care being taken to thoroughly drench both the aphides and red spiders. The plant is covered by a bell jar which rests upon a ring of cotton batting, so as to shut the plant off from the approach of insects or spores from without, and prevent the escape of those within. Under the bell jar are placed two cups of actively fermenting yeast.

May 14.—The plant carefully examined. No dead aphides to be found. A number of cast-off skins are seen. The aphides are well scattered over the plant, but more than the original twenty-seven can be counted. The red spiders are also scattered so that the number cannot be ascertained. Several living but no dead ones are seen. That the spiders should have decreased in numbers might be expected from the moisture of the yeast independent of the Torulæ.

Experiment No. 4.—April 8.—Selected a thrifty rose geranium, about ten inches high, that had by count seventy aphides upon it, collected mainly upon the tender shoots.

The yeast is prepared by dropping pieces of compressed yeast-cake, bought at the grocer's, into Pasteur's fluid with sugar. In

about twenty-four hours the yeast has become active as is shown by frothing and the budding of the Torulæ observed under the microscope. This active yeast is sprinkled all over the plant, care being taken to wet the bodies of as many aphides as possible. Over the plant is placed a bell jar to isolate it from others.

April 11. — No effects noticed. Sowed more of the same yeast.

April 18.—The soil in the flower-pot has been allowed to become quite dry. The larger leaves of the plant have turned yellow, and upon these are nearly all the aphides. Counting as carefully as possible, the number is found to be three hundred and fourteen. The glass cover is removed and nearly all the aphides are brushed off, and the plant allowed a few days to recuperate.

Experiment No. 5.—May 1.—Sowed yeast procured direct from the bakery upon the same plant as in No. 4. Upon the plant are fifty-five aphides, mostly small. The plant is placed in a close Wardian case where there is an abundance of moisture.

May 6.—A mold (Mucor) has made its appearance upon all parts where the yeast adheres. The aphides are nearly all dead or dying. One aphis is found alive held to the stem of the plant by a pasty mass of yeast.

May 16.—Only three aphides alive; the mold has seriously injured the plant.

Experiment No. 6.—May 26. — Sowed yeast from the same bakery as in No. 5 upon the aphides on a healthy young plant of same kind and size as No. 4. This time the plant was not treated differently from others in the same room except being thoroughly sprinkled with yeast.

June 3.—Aphides as numerous as ever. No dead ones seen.

Experiment No. 7.—To ascertain whether any fungoid growths could be developed from the dead aphides in No. 5, two of them are placed on a bit of clean, broken plant crock sufficiently moistened, which is covered with a small bell glass, the rim of which rests in a shallow vessel of water to isolate the experiment as completely as possible. The experiment commences May 5, at 2 P. M. On May 6, at 3.30 P. M., some mycelium is visible on the body of an aphis.

May 9. — A number of upright hyphæ have fruited; the quantity of fruit is very small and not sufficient to determine what the mold is with certainty, but it appears to be a Mucor.

Experiment No. 8.—This experiment is introduced as a test of No. 7.

May 11.—Two aphides are taken from a plant which has been treated with yeast. One is dead when found, the other is killed; both are placed as in No. 7. No mycelium or fungoid growth of any kind is developed in this experiment.

Experiment No. 9.—This experiment was introduced for the same purpose as No. 8.

May 11.—5.30 P. M. Three living aphides are taken from a plant not treated with yeast, and killed and placed as in No. 7.

May 13.—The room has been quite cool and no mycelium has appeared.

May 15.—On one of the aphides a few fruits of a mold can be discerned. None can be seen on the other two.

This experiment seems to show that the mold developed in experiment No. 7 on the body of the aphis which had died, has no connection with the fact that the plant from which the dead aphis was taken, had been treated with yeast.

The result of these experiments, as a whole, as also many others not here recorded which have a more or less direct bearing upon the subject under consideration, indicate plainly that yeast cannot be regarded as a reliable remedy against such insects as commonly affect plants cultivated in greenhouses, rooms and parlors. Moreover, it is more than probable that the yeast would injure many kinds of plants, especially those with delicate foliage by spotting and soiling the leaves, and inducing fungoid growths upon the jars or soil in which the plants are grown. Indeed, in most greenhouses at the present time, it is not so much a question of keeping down injurious insects, as it is the suppression of molds and mildews of various kinds. The verbena rust only need be named as an illustration of this point.

Nearly all recorded experiments with the yeast fungus as an insecticide, have been attended only by negative results. Among these may be mentioned those of Prof. J. H. Comstock, of the Department of Agriculture, who fed caterpillars in breeding cages with leaves wet with dilute yeast. They seemed to thrive as well as others not thus fed.

Mr. Wm. Trelease tried last August a number of experiments with yeast upon the cotton-worm, in the vicinity of Selma, Ala.[1]

These experiments were varied and carefully conducted. In

[1] "Report upon Cotton Insects." J. H. Comstock, Dept. of Agr. Washington, 1879.

some cases the cotton plants upon which the worms were feeding were thoroughly drenched with active yeast. In one instance a number of the larvæ were placed in a tin box and drenched for twenty-four hours with yeast; after this the surplus yeast was drained off and the larvæ kept in the same box and fed for a week without showing any symptoms of disease. They were then sent to the department at Washington, where they arrived safely, and never gave those receiving them cause to suppose that they had been thus treated. Similar results attended all the experiments tried by Mr. Trelease, and he was led to the conclusion that the proposed remedy could not be utilized for the destruction of the cotton caterpillar.

On the other hand, Dr. Hagen mentions some experiments made last summer by Mr. J. H. Burns, of Shelter Island, N. Y., on the potato beetle, as being successful. A quantity of beetles was divided into two parcels, one of which was sprinkled on successive days with dilute yeast.

On the eighth day those sprinkled began to die, and on the thirteenth all were dead. Of the unsprinkled parcel only a few had died. That this experiment is decisive can hardly be claimed, as it is probable that some other substance, as for instance, dilute flour paste, which would favor the growth of fungi, might have had the same effect as the yeast. At all events, the experiment must necessarily be tried upon the beetles as they are found in their natural state infesting the potato plants, before any definite conclusion can be drawn.

It is true that Dr. Hagen found spores in quantity in the large sinus of the wing of the dead beetles which had been sprinkled, but it does not appear that these were in any way directly connected with the Torulæ of the yeast. It should also be noted that Dr. Hagen states in the May number of the Canadian Entomologist, for 1880, that he has recently received a letter from Germany, giving an account of the use of the diluted (compressed) yeast upon aphides in a green-house, "which was successful to an exceeding degree;" but no details in regard to the experiment are given.

Possibly the kind of yeast used may make a great difference in the result, although it should be remembered that three different kinds have been used in the experiments detailed in this paper.

It is also worthy of note that yeast, as suggested by Prof.

Metschnikoff, might in some cases prove destructive to insects to which it had been applied, not because of the yeast itself, but because of impurities which it might contain, it being an established fact that yeast may and often does contain the living spores of more than one kind of fungus.[1]

One of the things which is always taken into account in the cultivation of fungi in the laboratory, is the fact that when we purposely sow the spores of a given fungus we are never quite sure that we are not at the same time unconsciously sowing the spores of some other fungus which may be floating in the air. While we expect and generally obtain an abundant crop of the fungus we may wish to cultivate, we are apt to find here and there one or more other forms mingled with those we are trying especially to grow. These may be compared to the weeds which the gardener is pretty certain to find among the plants he has sown in his seed-bed.

The subtle nature of fungoid growths of every grade, and the peculiar dependence of fungi upon climatic conditions and other circumstances, which are often unknown and wholly beyond control, are very important factors in estimating the probabilities of success by the methods under consideration. We know that epidemics and epizoötics of various kinds may be largely destructive and fatal one year, and the next, although the germs of disease must now be scattered in abundance everywhere, the disease is lessened or is wholly gone. Again, rust and smut may one season abruptly invade our grain-fields; the next it is scarcely seen; or blights and mildews may devastate for a few years our orchards and vineyards, and then gradually or suddenly disappear. Nor are these characteristics confined to microscopic fungi alone. During last season certain of the larger species, as Boletus and Hydnum, were sought in vain in localities about the University, where ordinarily they were abundant. The fall had been unusually dry and in this probably lay the cause of their non-appearance. Perhaps for the same reason, not a house-fly could be found that was affected with the Empusa, though they were sought for with much care, especially about the Botanical Laboratory where the yeast fungus was being grown.

Nevertheless, inasmuch as it is possible to suppress injurious fungi which destroy our economic insects, as for instance, the

[1] See *Nature* for March 11, 1880.

Muscardine in the case of the silk worm, the theory seems plausible that we may in time learn on the other hand, how to suppress injurious insects by fostering the growth of parasitic fungi which would spread infection among them and carry with it disease and death.

Finally, it must be confessed that the main question at issue is by no means decided, perhaps not seriously affected by the experiments and conclusions which I have here recorded. Though the yeast fungus may not be destructive to the insects named, and under the given conditions, it may, nevertheless, be destructive to other insects, or even to these under other conditions, or if the yeast fungus should prove to be wholly worthless and unreliable, it does not follow that there are not other forms which may be successfully employed as insecticides to the very great advantage of our most important national industry.

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LIST OF THE BIRDS OF THE WILLAMETTE VALLEY, OREGON.

BY O. B. JOHNSON.

[*Concluded from the July number.*]

40. *Poœcetes gramineus confinis* Bd. (Western grass finch).—Common during the summer, breeding extensively with the usual habits of the Eastern species.

41. *Chondestes grammicus* Say (lark finch).—Sparingly common during the summer, and breeding.

42. *Zonotrichia gambeli* Nutt. (Western white-crowned finch).—A very common summer resident, and nesting familiarly about gardens and thickets near dwellings.

43. *Zonotrichia coronata* Pall. (golden-crowned sparrow).—Sparingly common during summer and undoubtedly breeds, though I have not found its nest.

44. *Junco oregonus* Town. (Oregon snowbird).—Abundant during the winter and a few remaining to breed, the rest probably going to the mountains, where I hear of them. I have not yet seen its nest.

45. *Spizella socialis* Wil. (chipping sparrow).—A common summer resident, and breeding extensively with the usual habits of the species.

46. *Melospiza rufina* Bd. (rusty song sparrow). — A plentiful permanent resident, breeding commonly, and though I have found several nests with young, I have never seen its eggs.

47. *Passerella townsendi* Aud. (Townsend's fox sparrow).— Only a winter visitor; very shy and silent.

48. *Guiraca melanocephala* Swain. (black-headed grosbeak).— A common summer resident, breeding numerously.

49. *Cyanospiza amœna* Say (blue linnet).—An abundant songster during summer, and breeding plentifully.

50. *Pipilo oregonus* Bell (Oregon ground robin).—A common, constant resident, breeding numerously.

51. *Eremophila alpestris* Boie (horned lark).—An abundant summer visitor, nesting very commonly.

52. *Agelæus phœniceus* Linn. (swamp blackbird).—Very abundant in summer, breeding with the usual habits of the species.

53. *Agelæus gubernator* Wag. (red-shouldered blackbird). — Very abundant, with habits similar to the last.

54. *Sturnella neglecta* Aud. (Western field lark).—A constant resident, less common in winter; breeds.

55. *Icterus bullocki* Swain. (Western oriole).—Common in summer, breeding extensively.

56. *Scolecophagus cyanocephalus* Wag. (Brewer's blackbird).— Very abundant in summer, breeding numerously.

57. *Corvus carnivorus* Bart. (raven).—Not rare in the vicinity of Forest Grove; I have not seen its eggs.

58. *Corvus caurinus* Bd. (Western crow). — A common resident, breeding in communities.

59. *Picicorvus columbianus* Wil. (Clarke's crow).—Common in Cascade mountains, down to the foothills in winter. I have not seen its eggs.

60. *Pica hudsonica* Sab. (magpie).—Quite common in the vicinity of Forest Grove; it probably breeds, though I have not found its nest.

61. *Cyanura stelleri* Gmel. (Steller's jay).—An abundant resident, nesting in communities, at which time they are very silent.

62. *Cyanocitta californica* Vig. (California jay). — Common among deciduous trees, breeding about habitations.

63. *Perisoreus canadensis* Linn. (Canada jay). — Common in heavy timber in winter, probably breeds in mountains.

64. *Tyrannus verticalis* Say (Arkansas fly-catcher).—Common in summer, breeding in trees and about buildings.

65. *Sayornis nigricans* Swain. (black fly-catcher).—Saw a single example of this species in this place in July, 1879.

66. *Contopus borealis* Swain. (olive-sided fly-catcher).—Common in summer. I have not found its nest.

67. *Contopus richardsoni* Swain. (short-legged pewee).—Very common in summer, and breeds familiarly about orchards and houses; nest saddled upon a limb, composed of horsehair, strings and fine grass, and lined with cotton or wool; eggs usually three, sometimes four, cream-colored with dark-brown and lavender spots in a ring around the larger end. A set before me measure .66 by .54, .65 by .54, .65 by 53.

68. *Empidonax pusillus* Baird (little Western fly-catcher).—Quite common in summer, but I have not yet found its nest.

69. *Ceryle alcyon* Linn. (belted kingfisher).—Constant resident, breeds.

70. *Chordeiles popetue* Vieil. (night hawk).—Common in summer, breeding on gravely islands in the Willamette river.

71. *Chætura vauxi* Town. (Oregon swift).—I saw what I took to be this species in the Cascade mountains, in 1879.

72. *Selasphorus rufus* Gmel. (red-backed hummer).—A common summer resident, breeding; the only species observed.

73. *Coccygus americanus* Linn. (yellow-billed cuckoo).—Rare; I have seen two specimens killed in this vicinity.

74. *Picus harrisi* Aud. (Harris' woodpecker).—Common resident, breeding extensively.

75. *Picus gairdneri* Aud. (Gairdner's woodpecker).—Abundant, nesting in tops of dead willows.

76. *Sphyrapicus ruber* Gmel. (red-breasted woodpecker).—Not very common; I found a nest in a cottonwood "stub," about thirty feet from the ground, containing young.

77. *Hylotomus pileatus* Linn. (pileated woodpecker).—Common in heavily timbered districts. I have not seen its nest, but presume that it breeds in the "Great Burn" to the eastward.

78. *Melanerpes torquatus* Wil. (Lewis' woodpecker).—Common along the Columbia in winter, a few remaining to breed.

79. *Colaptes mexicanus* Swain. (red-shafted woodpecker).—Abundant, nesting commonly. I have seen twenty nests at once in the College buildings at Forest Grove, where they have cut holes through the frieze.

80. *Bubo virginianus* var. *pacificus* Cass (Pacific horned owl).—Quite common. I have not found its nest.

81. *Scops asio* Linn. (screech owl).—Very common, breeding in hollow trees.

82. *Syrnium cinereum* Gmel. (great gray owl).—Occasionally seen in heavily wooded districts.

83. *Nyctale acadica* Gmel. (acadian owl).—I have a single example that flew into an open transom at a jewelry store in this place.

84. *Glaucidium californicum* Sclat. (pigmy owl).—Quite common; I have not seen the nest. They are savage little fellows, and will attack cage birds in daylight, and I know of two that suffered death thereby.

85. *Nyctea nivea* Danel. (snowy owl).—Occasionally killed in winter by hunters in this vicinity.

86. *Aquila canadensis* Linn. (American golden eagle).—Occasionally killed by hunters in this vicinity.

87. *Haliaëtus leucocephalus* Linn. (white-headed eagle).—Common along the Columbia, nesting in high trees. I have seen them pick up young lambs as fast as they were dropped.

88. *Pandion carolinensis* Gmel. (fish hawk).—Common along the Columbia and Willamette rivers, nesting on trees.

89. *Falco sparverius* Linn. (sparrow hawk).—Very common, nesting in holes, usually of a woodpecker.

90. *Accipiter cooperi* Bon. (Cooper's hawk).—Occasionally seen.

91. *Accipiter mexicanus* Swain. (Mexican hawk).—I have a specimen that I refer to this species.

92. *Accipiter fuscus* Gmel. (sharp-shinned hawk).—Moderately common, nesting in hollow trees.

93. *Buteo montanus* Nutt. (Western red-tail hawk).—Common; I have not seen its nest.

94. *Buteo elegans* Cass. (elegant hawk).—A single example referable to this species.

95. *Circus hudsonicus* Linn. (marsh hawk).—Moderately common, breeding.

96. *Cathartes aura* Linn. (turkey buzzard).—Common during summer, sailing the air; have not seen its nest.

97. *Columba fasciata* Say (band-tailed pigeon).—An abundant summer resident, feeding chiefly on berries. They nest in various situations much like the common dove *(Z. carolinensis)*; I found

one of leaves and moss beside a tree, placed on the ground between two roots; another one upon an old stump that had been split and broken about eight feet from the ground; another was in the top of a fir (*A. grandis*), and was built of twigs laid upon the dense flat limb of the tree, about one hundred and eighty feet from the ground. These each had two eggs, pure white, and elliptical, differing from those of *Z. carolinensis* only in size; a set before me measure 1.60 by 1.20, 1.55 by 1.19. The first in my collection were obtained from the bodies of two females in 1877.

98. *Zenaidura carolinensis* Linn. (common dove).—An abundant summer resident, nesting commonly.

99. *Tetrao obscurus* Say (dusky grouse).—A common resident, breeding extensively.

100. *Bonasa sabini* Baird (Oregon grouse).—Very common along water courses, where it breeds.

101. *Ortyx virginiana* Linn. (Virginian partridge).—Introduced and doing finely.

102. *Oreortyx pictus* Doug. (plumed partridge).—Very common throughout Western Oregon, breeding extensively.

103. *Grus canadensis* Temm. (sand-hill crane).—Common during the migrations.

104. *Ardea herodias* L. (great blue heron).—A common resident, breeding in communities in tall trees.

105. *Botaurus minor* Bon. (bittern).—A common resident, breeds.

106. *Nyctiardea gardeni* Baird (night heron).—A single example, obtained May, 1876, near Salem.

107. *Ægialites vociferus* L. (killdeer).—A common resident, breeds.

108. *Squatarola helvetica* L. (black-bellied plover).—Occasionally shot during the migrations.

109. *Phalaropus hyperboreus* L. (Northern phalarope).—Occasional during the migrations.

110. *Gallinago wilsoni* Temm. (Wilson's snipe).—Abundant during the migrations, a few remaining to breed.

111. *Macrorhamphus griseus* Gmel. (gray snipe).—Occasional during the migrations.

112. *Tringa americana* Cass. (red-backed sandpiper).—Occasional during the migrations.

113. *Tringoides macularius* L. (spotted sandpiper).—Summer resident, breeding in favorite localities.

114. *Rallus virginianus* L. (Virginia rail).—Occasionally shot by sportsmen.

115. *Fulica americana* Gmel. (mud hen).—Common in winter along the Columbia river.

116. *Cygnus americanus* Sharp. (American swan).—Not rare during the migrations.

117. *Cygnus buccinator* Rich. (trumpet swan).—Common during the migrations.

118. *Anser hyperboreus* Pal. (snow goose).—Common during migrations.

119. *Anser gambeli* Hart. (white-fronted goose).—Common during migrations.

120. *Bernicla canadensis* Bon. (Canada goose).—Abundant during migrations.

121. *Bernicla hutchinsi* Bon. (Hutchin's goose).—Common during the migrations.

122. *Anas boscas* L. (mallard).—This and the eight following are abundant, during the migrations, along the Columbia and Willamette rivers and their tributaries.

123. *Dafila acuta* Jen. (springtail).

124. *Nettion carolinensis* (green-winged teal).

125. *Spatula clypeata* (spoonbill).

126. *Chaulelasmus streperus* L. (gadwall).

127. *Marecca americana* Gmel. (American widgeon).

128. *Aix sponsa* L. (wood duck).

129. *Fulix collaris* Dan. (ring-necked duck).

130. *Aythya americana* Eyt. (red head).

131. *Aythya vallisneria* Wil. (canvas-back).—Usually abundant during the month of February.

132. *Bucephala americana* Bon. (golden-eye).

133. *Bucephala albeola* L. (butter ball).—This and the preceding common during migrations.

134. *Mergus americanus* Cass. (sheldrake).—Common along water courses, a few remaining to breed.

135. *Mergus cucullatus* L. (hooded merganser).—Common during winter.

136. *Chræocephalus philadelphia* Ord. (Bonaparte's gull).—Driven into the interior by storms.

137. *Colymbus torquatus* Brün. (Northern diver).—Occasional along the rivers.

138. *Podiceps californicus* Her. (California grebe)—I saw an example that I referred to this species.

139. *Podiceps clarki* Lawr. (Clarke's grebe).—Occasional along the rivers.

140. *Podilymbus podiceps* L. (dabchick).—More common than the last.

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DO FLYING FISH FLY?

BY C. O. WHITMAN.

OF all the modes of animal locomotion, none has excited more general attention than that of flying creatures; and this is none the less so now that many of those who believe in the ultimate success of "the flying machine," have discarded the balloon theory, and come to regard nature's contrivances for flight as the true models for aërial locomotives. Among those animals that enjoy the much-envied power of flight, none has elicited such universal interest and comment, from old and young, layman and scientist, as that anomalous member of the finny tribe, the flying fish. Science, poetry and fable have conspired to extend the fame of this little denizen of tropical seas, and philosophy has more than once attempted to find some adequate cause for the enormous development of its pectoral limbs, hoping to find here one more important link between swimming and flying animals.

This fish owes its generic name to a curious belief which is said to have been current among the ancients. They supposed that the flying fish —"sea swallows" they called them—left the ocean at night and slept on shore, to avoid the attacks of their marine enemies. From this habit of "sleeping out," they were called *Exocœti*.

Besides Exocœtus, which includes between forty and fifty different species, there is a genus of flying fish called *Dactylopterus* (finger-winged), from the fact that the fin rays extend, finger-like, beyond the margin of the fins. This genus, popularly named the flying gurnard, is represented by comparatively few species which inhabit the Atlantic, the Mediterranean sea, the Indian ocean and archipelago, and the Japan seas.

To those who may never have had the opportunity to observe

the flight of these fishes, it may seem a matter of no little surprise that it is still an unsettled question whether they fly or skim. The difference of opinion on this point is all the more remarkable as the flying fish has been known, at least, since the time of Pliny, and even of Aristotle, and has always attracted the attention of voyagers. Although its aërial flight, to accomplish which it has to leave its native element, is not at all more remarkable than the sub-aquatic flight of the quillemots, grebes, auks and penguins, all of which are accustomed to exchange temporarily their own element for that of the finny race, to move through the water with even greater rapidity than the fishes themselves, and to remain submerged longer than the flying fish remains above water; and although the modification of the fins for aërial locomotion is certainly not greater than that of the wings of the auks and penguins for flight under water; yet the testimony of able scientific witnesses, in favor of the actual flight of Exocœtus, has been often challenged by equally good observers, and plausible reasons have recently been urged against even the possibility of such flight.

It is maintained by many, perhaps the majority of observers, that the Exocœti are sustained by the parachute-like action of the pectoral fins, which they simply hold outstretched during their passage through the air. According to this view the fins exhibit none of that "poetry of motion" seen in the bird's wing, being capable of only a passive kite-like action, like the membrane-wings of the flying squirrel *(Pteromys)*, the flying lemur *(Galeopithecus)*, the marsupial Petaurists *(Petaurus* Shaw.) or the foot-web of the flying frog of Borneo.[1]

In one of our popular "natural histories" the flight of the flying fish is explained in the following manner: "These fishes possess the power of darting from the water into the air, and by the mingled force of the impetus with which they spring from the surface and the widely spread wing-like fins, to sustain themselves for a short space in the thinner element, and usurp for a time the privileges of the winged beings whose trackless path is through the air."

"The passage of this fish through the atmosphere can lay no just claim to the title of flight, for the creature does not flap the wing-like pectoral fins on which it is upborne."[2]

[1] Described by Wallace in his "Malay Archipelago."

[2] Wood's "Natural History."

The following statement to the same effect is found in "The Ocean World," by Louis Figuier: "Their fins sustain them rather as parachutes than wings."

In Beeton's "Dictionary of Natural History," the author speaks thus: "Although some few naturalists have supposed that these fish possess the true power of flying, that is, by beating the air with their members, it is generally agreed that their large fins sustain them parachute-wise when they have leapt from the water."

In the same place occurs a quotation from Bennett's "Wanderings in New South Wales," which is here given in full, as it contains some statements which have found quite general acceptance among scientific men.

Mr. Bennett says, "I have never been able to see any percussion of the pectoral fins during flight, and the greatest length of time that I have seen this fish on the fin has been thirty seconds by the watch; and the longest flight mentioned by Capt. Hall[1] is two hundred yards; but he thinks that subsequent observation has extended the space. The most usual height of flight, as seen above the surface of the water, is from two to three feet; but I have known them come on board a ship at a height of fourteen feet; and they have been well ascertained to have come into the channels of a man-of-war, which is considered as high as twenty feet and upwards. But it must not be supposed they have the power of elevating themselves after leaving their native element; for on watching them, I have often seen them fall much below the elevation at which they first rose from the water, but never in any one instance could I observe them rise from the height at which they first sprang; for I regard the elevation they take to depend on the power of the first spring or leap they make on leaving their native element."

Burmeister in his "Reise nach Brasilien" (Berlin, 1853, p. 36), declares that he watched the flying fish for a long time, and saw, with certainty, "that they made no kind of movement with their large pectoral fins, but held them quietly outspread like a parachute."

In his well-known work on "Animal Locomotion" (p. 98), Pettigrew says: "Whether the flying fish uses its greatly expanded pectoral fins as a bird its wings, or only as parachutes,

[1] "Lieutenant and Commander," by Capt. Basil Hall.

has not, so far as I am aware, been determined by actual observation. Most observers are of opinion that these singular creatures glide up the wind, and do not beat it after the manner of birds; so that their flight (or rather leap) is indicated by the arc of a circle, the sea supplying the chord."

From a careful examination of the structure and action of these fins, Pettigrew has been able to satisfy himself that "they act as true pinions within certain limits." That this restrictive phrase, "within certain limits," is intended to exclude a flapping motion, is evident from the following: "The flapping and gliding action of the wings constitute the difference between ordinary flight and that known as skimming or sailing flight. The flight of the flying fish is to be regarded rather as an example of the latter than the former, the fish transferring the velocity acquired by the vigorous lashing of its tail in the water to the air."

Pettigrew shows that all kinds of wings, when extended in flight, have a kite-like action, or a "combined parachute and wedge action" independent of any beating movement; and it is to this action alone that he refers when he says the pectorals "act as true pinions *within* certain limits."

According to Pettigrew, "Mr. Swainson, in crossing the line in 1816, zealously attempted to discover the true action of the fins in question; but the flight of the fish is so rapid that he utterly failed." So much for the negative testimony.

In favor of the flapping motion of these fins, we have the testimony of Capt. de Freminville,[1] who says, "I have been able to convince myself that they [flying fish] do actually fly, impressing upon their fins, which serve them as wings, a rapid movement—a species of vibration [frémissement]—which sustains them and causes them to advance through the air."

Speaking of these fish, which he saw on the way from Callao to Lima, U. de Tessan[2] says: "J'ai très-bien vu un poisson-volant battre d'abord des ailes en l'air, et puis les faire vibrer en planant."

In the "Reise der Oesterreichischen Fregatte *Novara* um die Erde" (1857–1859), published by Wüllerstorf-Urbair, 1861, p. 109, occurs (according to Möbius) the following: "Careful ob-

[1] *Ann. des Sci. Nat.*, Vol. XXI, p. 102, 1830.

[2] "Voyage autour du Monde sur la *Vénus*," Paris, 1844.

servation enables one to see that the wing-like pectoral fins of the flying fish are capable of a vibrating movement, like the wings of a grasshopper."

Dr. Kneeland[1] makes the following noteworthy statements as the result of observations made in 1870, on a voyage from San Francisco to Panama: "The ventrals were expanded like the pectorals in the act of flight. They rose out of a perfectly smooth sea, showing that they are not mere skippers from the top of one wave to another; they could be seen to change their course as well as to rise and fall, not unfrequently touching the longer, lower lobe of the tail to the surface, and again rising, as if they used the tail as a powerful spring. While the ventrals may have acted chiefly as a parachute, it seemed that the pectorals performed, by their almost imperceptible but rapid vibrations, the function of true flight."

To the same effect speaks A. v. Humboldt[2] when he says, "Notwithstanding the astonishing swiftness of their movement, one can convince oneself that the animal beats the air during its spring, *i. e., that it alternately opens and closes its pectoral fins.*"

In his work "On the Origin of Species" (p. 175), the great naturalist remarks: "It is conceivable that flying fish, which now glide far through the air, slightly rising and turning by the aid of their fluttering fins, might have been modified into perfectly winged animals. If this had been effected, who would have ever imagined that in an early transitional state they had been the inhabitants of the open ocean, and had used their incipient organs of flight exclusively, as far as we know, to escape being devoured by other fish?"

Without attempting to make this bibliographic sketch exhaustive—an infeasible undertaking with the libraries at my command—I will now pass to my own observations on the flight of flying fish, made during a voyage from San Francisco to Yokohama, on the steamer *City of Peking*, reserving till the last the consideration of the recent elaborate paper of Prof. Carl Möbius.[3]

Of the nearly twenty-three days that elapsed between departure and arrival (Aug. 1 to Aug. 24, 1879), at least ten were favorable for the study of the question under consideration.

[1] Proceed. Boston Soc. Nat. Hist., Vol. XIV, p. 138, 1872.

[2] "Reise in die Aequinoctial-Gegenden des neuen Continents," I, Stuttgart, 1815.

[3] "Die Bewegungen der fliegenden Fische durch die Luft." *Zeitschrift für Wissenschaftliche Zoologie*, Supplement to Vol. XXX, p. 343, 1878.

Aware that these fish are now generally regarded as skimmers rather than flyers, notwithstanding the testimony of very trustworthy observers to the contrary, I determined to satisfy myself, if possible, on this one important point.

I found the most favorable place for observation to be the bow of the steamer, and the best hours to be in the morning from five till eight or nine o'clock, and in the afternoon between three and six o'clock. Observations made when the air was quiet and the sea perfectly smooth, so that the fish could often be seen before they left the water, were the most satisfactory and conclusive. A stiff breeze, a billowy sea, a tossing ship and an easy chair are not conditions which facilitate accurate observation, and to such conditions, doubtless, is to be attributed the ill-success of many who have undertaken to decide this question.

It has often been stated, especially by those who deny the wing-like motion of the fins, that flying fish are seldom seen above water when the air is still, and Burmeister even goes so far as to say that "they fly *only* when there is considerable wind, since it is the wind which supports them."

That Burmeister "never saw a flying fish by still air," proves only his misfortune, either in having no opportunity to see, or in not improving the opportunities which he did have. I have often seen great numbers of these fish when the air was almost motionless—so still that not a ripple could be discerned on the glassy surface of the water—and it seemed to me that they were not much, if at all, less numerous on such occasions than when there was a moderate wind.

Under the favorable conditions before mentioned, it is by no means difficult to determine whether the fish executes any flapping movements with its pectoral fins. As I have seen them come out of the water directly under my eyes, I have been able to see distinctly the individual flaps of the large pectorals, while the ventrals were held in quiet expansion. The flapping movement, which is quite regular and rapid—so rapid that it is not easily recognized at any great distance until experience has sharpened the eye—may be continued for the whole, or a part of the flight; but is *generally* discontinued after the first few rods, and the course completed by a pure skimming or sailing movement. In some cases I have seen the flapping of the fins renewed once or twice after short intervals of the sailing movement. In

the case of young fish, from a-half to one and a-half inches in length, many of which I saw leave their native element to essay the rarer medium, the strokes of the fins are continued throughout the short flight; and the resemblance between these tiny fin-flyers and flying insects is most striking.

The course of the flight is generally in a straight or curved line; but on several occasions I have seen it abruptly changed, apparently by the aid of the tail, the lower lobe of which was brought for a moment into contact with the water.

In one instance I saw the course thus changed three times, at intervals of only a few seconds. The fish came out of the water only a few feet from the steamer, flew outward and backward, then, suddenly turning, came toward the steamer, striking the crest of a wave within a few feet of the same, it darted alongside, and again dipping its caudal lobe in the water, wheeled directly away from the boat and plunged into the ocean. In the majority of observed cases, where the tail was made to touch momentarily the water, the course was not changed, the tail appearing to act, as Dr. Kneeland has already remarked, like a spring for raising the fish.

In the case of a breeze, the direction of flight, as a rule, was either against that of the wind, or formed a more or less acute angle with it; not unfrequently, however, the flight is with the wind, or at right angles to it.

The longest flight observed lasted not less than forty seconds, and its extent was undoubtedly over eight hundred feet, and may have exceeded twelve hundred feet. This remarkably long flight began near the right side of the steamer and was performed in a long curve, which formed, at first, nearly a right angle with the boat, then moving directly against a gentle wind, but gradually turned backward, so as finally to coincide nearly with the direction of the wind.

While the average flight does not perhaps exceed fifteen seconds, nor extend above four or five hundred feet, yet I have observed numerous cases in which it was continued twenty to thirty seconds.

That this flight, executed in a horizontal plane, which, according to the concurrent testimony of all observers, is seldom raised above the surface of the water by more than two or three feet, continued for ten to thirty or forty seconds, and extending a dis-

tance of one to eight or more hundred feet, can be due to the impetus gained by a single spring combined with the parachute-like action of the fins, seems to me, aside from the oft repeated testimony of my eyes, quite incredible.

It is maintained, however, by Carl Möbius, professor in Kiel, in the article before mentioned, that the pectorals of the flying fish execute no flapping movement during flight; and this view is based not only on the author's observation of the flight of many Exocœti and one Dactylopterus, but also on anatomical and physiological grounds.

No one, so far as I know, has undertaken so elaborate a discussion of this question, and approached it from so many different standpoints as Prof. Möbius; and his conclusions will, on this very account, undoubtedly command the assent of many naturalists who have had no opportunity to settle the question for themselves. It is not, therefore, surprising to find that Prof. Bardeleben, in his review of this paper, in Hofman and Schwalbe's "Jahresberichte über die Fortschritte der Anatomie und Physiologie" (Vol. VII, part I, p. 129), appears to accept as conclusive the opinion so ably maintained by Prof. Möbius. Had I not seen many times, with my own eyes, under circumstances so favorable as to forbid all manner of doubt in my own mind, the flapping of these fins, I might have accepted the conclusions of the German naturalist and overlooked the assailable points of the arguments adduced in their support; but with the positive assurance that he is in error on the main question, I have been led to question the validity of some of his interpretations of facts. That I have fairly stated the position of this author in regard to the function of the pectoral fins of the flying fish, will appear evident from the following citations:

"If during the entire flight the pectoral fins of flying fishes actually made motions similar to those of the wings of bats, birds and insects, one would be able to perceive them quite as well as the strokes of equally large wings of bats and birds" (p. 353).

This statement is open to the objection that it entirely ignores the fact that the color of the fins, the rapidity and sweep of their vibrations have a vast deal to do with the question whether the fin-strokes would be as easily recognized as the wing-strokes of the bird or bat.

"Flapping movements of the large shining pectorals would

make themselves visible by the alternate appearance and disappearance of the light reflected from them. They would escape no accurate observer who viewed the fully expanded pectorals from the height of a steamer. But as often and as long as I have been able to follow with my eyes flying fish, which came out of the water near our boat, I have never seen light reflected in this manner from the pectoral fins as from the wings of birds and bats" (p. 353).

That these movements have escaped Carl Möbius is then evident from his own testimony; what application then is to be made of the statement that "they would escape no accurate observer?" This author first attempts to account for the fact that many good observers have affirmed the wing-like movement of the fins on historical and psycological grounds, asserting that this "false notion" had its origin in a fancied resemblance of these fishes to swallows, and that it has been handed down from the times of Aristotle and Pliny to the present time, simply on authority; and afterward, as if aware that this was not altogether a satisfactory solution of the question, admits that these observers may have had some grounds for their statements, but thinks they were deceived by appearances, which they did not understand, into the belief that the fins behave like wings. He is very frank in telling us just what these appearances are, although no one, not even Möbius himself, has ever observed such phenomena in a living Exocœtus.

"Just as a sail begins to slacken and vibrate the moment the wind blows parallel to its surface, so the more flexible and elastic distal and ventral parts of the pectoral fins are thrown into rapid vibrations when the air-current moves parallel to their surface" (p. 370).

As a simile, this will do very well, but how is it as a matter of fact? We are assured that this comparison is fully justified by the following simple experiment. A specimen of Exocœtus shriveled, distorted and stiffened by long soaking in alcohol, was suspended and its pectorals exposed to a swift current of air in such a manner that the current swept along both surfaces. The fins thus exposed "made directly under my eyes the same rapid quivering movement that various good observers of flying fish have regarded as a flying movement" (p. 370–371). It is important to observe that Möbius has here affirmed an identity without any authority whatever. He shows his deference to the statements of "good observers," by undertaking to sweep all their

testimony out of court by the mere breath of his private opinion. Surely this is a most facile mode of reconciling contradictory testimony!

If Möbius merely announces it as his *opinion* that the tremulous movement observed in his experiment is identical with the movement that has been so often interpreted as a true flying movement, then we have simply to raise objections.

There are three questions here to be considered: First, whether the fins probably exhibit such movement; second, whether such a movement, if made, would be probably recognized; and third, whether, if recognized, it would likely deceive "good observers."

It would seem that the wings of a sailing bird, such as a gull or a hawk, would be quite as likely to exhibit such motion as the fins of the flying fish; and it would be much more easily recognized in the former than in the latter.

With reference to this point, I watched the long-winged gulls that were seen almost every day of our voyage. These birds were often circling about the stern of the boat, on the watch for waste bits of food, and were remarkably good skimmers, moving the most of the time without flapping the wings. I very rarely saw any vibratory movement that could be attributed to the wind alone, and *never* anything of the kind that was of more than a momentary duration. It is very evident that, under conditions that would render possible a continuous movement of this kind, the bird, as well as the fish, would inevitably fall to the water.

Is it probable that a momentary quiver in the comparatively small fin-wings of a swiftly-moving flying fish would be noticed? The fact that no naturalist has ever affirmed anything of the kind except Möbius, who bases his assertion on an experiment with an alcoholic specimen, is sufficient answer to this question.

As to the probability of any one being deceived by such motion, I cannot, of course, judge from experience, as I have never been so fortunate as, in the first place, to detect it, and, in the second place, to discover that I had erroneously interpreted it. I cannot persuade myself, however, that any "good observer" would be likely to make such an egregious blunder.

That Möbius does not regard this hypothetical quivering as in any sense a true flying movement, he states in the most unequivocal manner, and goes on to ask, "how, then, are the Exocœti able, without touching the water, to rise over the waves? For

this also they make no fin-strokes. They do not raise themselves, but are passively raised by the ascending currents of air, which are caught in the grooves on the under surface of their pectoral fins" (p. 371). Notwithstanding the oft-repeated affirmation that flying fish do not actually fly, our author seems, in one place, to admit the possibility of the flapping of the fins during flight. "These explanations of the movement of the flying fish do not imply that an Exocœtus or a Dactylopterus cannot make powerful and plainly recognizable movements with its tail and pectorals during its ascent (out of the water), and even occasionally in the middle of its course, if prompted thereto by a strong wetting of the body by the waves" (p. 372).

This statement, interpreted in the light of the context, cannot be said, however, to involve a contradiction; the author simply means that the fins and tail may be used in getting out of the water, and that these movements may possibly be recognized just as the fish rises. But he still maintains that the wing-like movement attributed to them by many observers, "arises not through muscular action, but through the elasticity of the out-spread fins and the pressure of the air, which act alternately against each other" (353–354).

Passing on from these explanations, which presume to reconcile conflicting statements by pronouncing all that will not be reconciled, fallacious, and by substituting others of a less obstinate but of a purely hypothetic nature, which seem to admit of a quasi-explanation, we have next to notice the arguments urged from an anatomical and physiological standpoint.

"I believe then," says Möbius, "that I have refuted on anatomical and physiological grounds, the opinion that flying fish use the pectoral fins as wings" (p. 368).

In this entire discussion, Möbius tacitly assumes that there can be but two opinions on this question, namely: his own opinion, which he shares with many others, and the opinion attributed, with more or less justice, to A. v. Humboldt, Kneeland and others, *that the fins are flapped with great rapidity throughout the entire flight.* While the claim to have refuted the latter opinion seems altogether too pretentious, it may be freely admitted that the reasons adduced have much more force against it than against the view here maintained, that the flapping movement is *generally* continued for only a part of the flight.

The frequency of the fin-strokes is made the first point of attack. Referring to the number of revolutions made by the bird's wing per second, which, according to Marey,[1] are for the

Sparrow	13
Wild duck	9
Pigeon	8
Moor buzzard	5¾
Screech owl	5
Buzzard	3

Möbius remarks: "If flying fish make a still larger number of fin-strokes per second, then the fin-muscles must be able to contract even more rapidly than the pectoral muscles of birds and all other vertebrates." Then follows a comparison of the muscles of certain fishes with those of mammals, birds and frogs, in respect to the time required to execute a muscular contraction—all with a view to showing that the muscles of Exocœtus are incapable of making very rapid contractions. The strength of this argument is impaired by two facts; first, the duration of a muscular contraction has never been determined for Exocœtus; and second, the number of fin-strokes per second has never been estimated, much less experimentally ascertained.

Furthermore, it does not follow, as Möbius asserts, that if the flying fish make more than thirteen fin-strokes per second, its fin-muscles must be able to contract more rapidly than those of birds. That they would be more rapid than those of *some* birds under *some* circumstances, can be safely asserted, and nothing more. The number of revolutions made by the sparrow's wing in a second is greatly exceeded in the wing of the humming-bird; and the figure given by Marey does not represent the maximum number of strokes of which the sparrow's wing is capable. A complete "muscle-curve" consists of a "*latent period*," a *contraction* and a *relaxation*, as every tyro in physiology knows, and the last two phases may vary much in duration according to circumstances.

Again, the size of the fin-muscles is said to be incompatible with the theory that the fins execute true flight.

The average weight of the entire bird, as determined by Harting for thirteen birds belonging to different orders, is 6.22 times that of the pectoral muscles. In the case of Chiroptera, according to the Dutch physiologist, the body weighs 13.6 times

[1] "Animal Mechanism," p. 228.

as much as the pectoral muscles; and the relation between the same in Exocœtus was found, by Möbius, to be as 32.4:1.

If the work performed by the muscles of flight be proportional to the weight of the body, then, as Möbius observes, the pectoral fin-muscles of Exocœtus must develop about five times as much force as the pectoral muscles of birds, and about two and one-half times as much as the same muscles of the bats.

The objection from this point of view has been greatly over-estimated by Möbius. As flying fish generally move their pectorals during only a part of their flight, which is at most short, they do not need to expend so much muscular energy as birds and bats, which take long continued flights. Small muscles may perform, for a brief period, work which only larger muscles would be able to perform for a long time. Möbius seems to have overlooked the fact that *time*, as well as size, is an element of this problem.

Perhaps also the large air-bladder may, as Humboldt supposed, have something to do with lightening the work of the muscles, while serving as a store-house of oxygen.

The experiment of Humboldt, by which he determined that the fin-rays of Exocœtus move with five times greater force than the rays of other fins, would seem to favor the opinion here maintained.

Admitting that in form, size, length and structure the pectoral fins of Exocœtus are less well adapted to flight than the wings of most birds, there is still ample room to believe, on anatomical and physiological grounds alone, that they are capable of executing true flight.

In regard to the personal observations of Prof. Möbius, it may be said that they can lay no claim to the right of deciding this question. Whatever evidence they afford is of a purely negative character; and of this fact Prof. Möbius seems to be fully aware, if we may judge from the stress which he lays upon other considerations.

That Möbius and others may not have been fortunate enough to recognize the wing-like motion of the pectorals, establishes at most only a probability, which weighs very little against the positive evidence afforded by the testimony of those who have actually seen flying fish fly.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The reasons why governments should foster scientific research, are simply those which render it important that the sciences should exist. We take those reasons to be as follows: Firstly, the importance of developing the rational part of the minds of the race coincidentally with progress in other directions. Scientific publications stimulate thought, both by adding to the materials of thought and by opening up new directions for its activity. At the foundation of scientific publication and its functions lies original research, which is the source of all knowledge. The relation of knowledge to the habit of rational thought is obvious. The importance of the rational habit of mind in the individual and in the nation, cannot be over-estimated. It affects the daily intercourse of men more than any other quality, since it is the essential element in morals and in personal viability.

Secondly, scientific research is essentially important in the light which it throws on our physical relations to our environment, and the command it gives us over the resources of the world in the amelioration and elevation of our physical condition. This, popularly spoken of as the primary mission of science, is nevertheless second in order of importance.

Thirdly, the cultivation of science is beneficial to the community in affording material for the pleasurable occupation of time, and through the interest which it evokes, in furnishing an antidote to ever mischievous idleness. Its attractions doubtless serve to divert the mind from activities of a character injurious both to the individual and to the community.

The encouragement and support of scientific research is then, evidently a duty of governments, as involving most important parts of the interests of their peoples. That this has been the opinion of most civilized nations is well known. The great scientific works of many of the European nations are among their chief glories.

The peculiar character of our own government offers an inviting field for the establishment of organizations for the development of knowledge through the aid of the National Treasury; and thanks to the energy of private citizens and others, a number of such organizations have already reflected great credit on our legislators, and have placed American scientific work on a plane with that of the old world. But our opportunity is also our danger.

It is easy to understand that access to the national resources is as open to place hunters as to scientific men, and that personal jealousies and private ambition may hope for easier successes than under any other form of government.

We allude to this subject for the purpose of pointing out two prominent instances of the introduction of demagoguery into scientific politics, so to speak, in the belief that unless "eternal vigilance" is exercised in this direction, scientific interests will undoubtedly lose that influence in the councils of the government, which has hitherto proven so beneficial to the progress of knowledge.

The sentiment has been propagated that our government should not foster scientific research, because it thus becomes "a crushing competitor" of private scientific enterprise.[1] While such an expression as this could not emanate from a scientific man, it might have some influence did not scientific men distinctly repudiate it. We are aware that it has been used with effect in some quarters, by persons who would like to be regarded as scientific men. We maintain that such a sentiment as the above, effectually settles their claim to such consideration. Such language would indeed be quite inexplicable had it not been accompanied by the additional assertion that Congress should employ scientific research for the development of the material resources of the country. This looks like an appeal to the cupidity of legislators in favor of certain kinds of science as against other kinds. If this be so, we believe that this is the first time in our history that any one has sought success for a scientific enterprise by such methods. The custom has been hitherto to appeal to material interests in justification of pure science; and to such a policy on the part of scientists are we indebted for most of our great government works on purely scientific subjects.

But the appearance of tampering with the interests of pure science has been still more evident in certain official documents issued not many months ago.[2] Specific objections have been made against certain departments by *soi disant* scientists who desire aid for their own specialties. A more short-sighted policy cannot well be conceived; for objections fairly lodged in the minds of Congressmen, can be turned in any direction with great facility. We suggest to our friends, whether all may not suffer alike through the short-sighted selfishness of persons who do not hesitate to push their supposed private interests by attempting to destroy existing institutions which are in the field before them. We ask whether there is not some risk that the government system of subsidies to science, which have been built up at the expense of much talent and toil, may be destroyed through the jealousies of a few unpatriotic persons calling themselves scientific men?

[1] See AM. NATURALIST, March, 1879.

[2] Report on the Methods of Surveying the Public Domain, Oct., 1878.

RECENT LITERATURE.

SOME RECENT PUBLICATIONS ON JAPANESE ARCHÆOLOGY. — Doubtless many readers of the NATURALIST may have seen a review in *Nature* of my memoir on the Shell Mounds of Omori, and in the same journal my reply and protest against the gross misrepresentations which that review contained. My reply was prefaced by an unexpected letter from Charles Darwin, in which he not only speaks of the "very scant justice" done to my work in the review, but compliments the Japanese for their part in the matter. This answer called forth a second letter of considerable length, for which *Nature* seemed to find ample room.

This second letter consisted mainly in extracts from a recent paper on Japanese archæology by Prof. John Milne. My reply to this consisted mainly in a review of Mr. Milne's paper, and on this ground alone the editor of *Nature* might have seen fit to publish it. My article was returned to me, however, as too long. As it is impossible to shorten it much, and as another publication on archæological subjects has recently appeared in Japan, which demands notice, a review of both papers may possibly bring out some features of interest to those studying these subjects.

It is hardly necessary to add that my only excuse for noticing the efforts of Mr. Dickins is, that his letters appear in one of the widest and best known journals of science.

It is difficult to see that Mr. Dickins has at all met the points I protested against in my first letter. In other words he not only did "very scant justice" to my memoir, to use Mr. Darwin's temperate words, but he showed a lamentable ignorance of the work he attempted to review. A single illustration will suffice.

In his first article he says: "These mounds consist for the most part of shells *little if at all distinguishable from what are still to be found in abundance* along the shores of the Gulf of Yedo." The italics are mine.

My memoir shows that the species composing the deposit are different in their form, size, proportions of parts and relative abundance from similar species living to-day, and that one of the most abundant shells in the mounds is not found nearer than four hundred miles to the south-west, while others are rarely found in the Gulf of Yedo.

Observe now the "spirit of truth" which Mr. Dickins says animated him in writing his review. Having suddenly discovered that somebody else offers a possible explanation of the cause of these changes, Mr. Dickins for the first time recognizes the fact of these differences by quotations which are taken from my memoir.

Mr. Dickins parades with evident exultation the paper of Prof. John Milne published in the Transactions of the Asiatic Society of Japan, and since of the three names Mr. Dickins mentioned, Prof. Milne is the only one that can lay any claim to having pub-

lished on the matter, a review of his paper becomes a disagreeable necessity. Let us see then if Prof. Milne's paper can be regarded in the light of a contribution to science.

This paper appears in the Transactions of the Asiatic Society of Japan, Vol. VIII, Part I. It is entitled "Notes on Stone Implements from Otaru and Hakodate, with a few general remarks on the Prehistoric Remains of Japan."

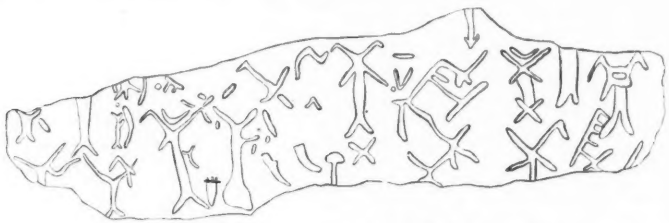
An idea may be formed of the loose way in which measurements are taken by the following. Speaking of certain stone implements he says: "These are *about* one inch long, having a curved scraping edge one inch broad." Again, "Its total length is *about* two and a-half inches, the pointed portion which is roughly rounded being *about* one and a-half inches." (The italics are mine.)

Zoölogists will hardly agree in an opinion advanced by Prof. Milne regarding the remarkable differences observed in the shells of the Omori mounds compared with recent forms. This opinion is that these changes have been induced by the upheaval of the shore, *during recent times* (the italics are his), and that as a result of this, of course one species has been driven four hundred miles further south! Also that the growing up of a few cities within the last few hundred years, may have so vitiated the waters of the gulf as to have helped change the appearance of these species *during recent times*. When it is considered that this body of water contains nearly a thousand square miles of surface, with changing tides, and that the populations which have been growing up have not been accompanied by chemical works, tanneries, slaughter houses and other manufactories which are among the chief agencies to vitiate the water, and furthermore that that portion which makes up the filthy sewerage in European cities is largely conveyed inland and emptied on the rice fields, the supposition of Prof. Milne becomes simply ridiculous. If convincing proof is wanted of the absurdity of this idea, an illustration is at hand in *Mya arenaria*. This species very quickly shows the impurity of the water, either from the admission of fresh water or from the water being cut off from ready access to the tides. The small and stunted specimens occurring in certain estuaries are examples. More curious illustrations may be seen in the stunted and distorted forms of this species which formerly occurred in the Loch of Stennis in Orkney, and in the sluices of Ostend. It was suggested by Forbes and Hanley that the singular varieties of *Mya arenaria*, known as *Mya lata* and *Mya pullus*, which occur in the mammaliferous crag of the east of England, may have been due to a freshening of the water at that time from melting ice. However that may be, *Mya arenaria*, by its diminishing size and abnormal growth, indicates the impurity of the water in which it lives. Fortunately *Mya arenaria*—the typical northern form—lives in the Gulf of Yedo to-day, and its shells are found in the

mounds of Omori. A comparison of the recent with the ancient forms show the least possible change, with the present form *slightly larger* and just as perfectly developed.

Prof. Milne will be called upon to give his authority for the statement that the Ainos have platycnemic tibiæ! Until some explanation is made, archæologists will please look to Prof. Milne as an authority for this remarkable statement. We may add, by the way, that Aino skeletons are such a drug in the market that there can be no difficulty in verifying this statement!

A most wretched and misleading cut is given of some rock inscriptions from Otaru. In order that the hieroglyphists may have some conception of the appearance of these curious inscriptions, we present a figure reduced from a drawing made by a Japanese gentleman, Mr. Morishima.



Rock Inscriptions from Otaru, west coast of Yezo. Scale 1-30.

In proof that the Ainos are pot makers, the following overwhelming evidence is given: "Mr. Charles Maries when traveling over Horidzume on the eastern coast of Yezo saw at the houses of the Ainos clay vessels *in appearance very like* the fragments obtained from the *shell heaps, and he believes* that the Ainos in that district still manufacture pots!" (The italics are mine.) In another sentence we are told that the Ainos have given up the art of pottery making since coming in contact with the Japanese, as they could purchase the ware cheaper than they could manufacture. Mr. Dickins has amused those familiar with Japanese faience by finding a resemblance between the shell heap pottery and Banko. Is it not more than likely that Mr. Maries has made a similar mistake. (I met this gentleman in Yezo, and found him a most delightful and entertaining acquaintance, but laying no more claim to a knowledge of these subjects than I do of the trees, the seeds of which he was sent out from England to collect.) I have also crossed Yezo from the west coast, have visited a great many Aino villages, examined a great many interiors and identified the pottery and lacquer used by the Ainos, and failed to find any evidence that they are to be regarded as pot makers in any sense of the word.

In the following manner does Prof. Milne suggest that the Ainos might have been cannibals. He finds in a number of old

books references to their cruel modes of punishments, and says: "There are many references given which show that the Ainos, a few hundred years before they were properly subdued, possessed a character which was sufficiently cruel to render it unnecessary to extend our imagination very far beyond the incidents which are there recorded, to see them practicing cannibalism." Extend our imagination! Very well, let us extend our imagination in the following case. In the records of the dreadful persecutions in Scotland two hundred years ago, persecutions so zealously maintained by that class who had the moral welfare of the people in charge; we read, among hundreds of accounts of the most atrocious tortures, of one "who remained in the same machine for eleven days and eleven nights, whose legs were broken daily for fourteen days in the boots, and who was so scourged that the whole skin was torn from the body." From this evidence, according to Prof. Milne, we are not even justified in extending our imagination far beyond this time to see the Scots practicing cannibalism!

In the following paragraph which is here quoted from Prof. Milne's paper, we must accuse the writer either of deliberate misrepresentation or of careless ignorance:

"Prof. Morse in describing the mounds of Omori, gives a list of the 'Objects not found at Omori.' About these we will make no remark. In these shell heaps, or scattered through the ground near them, stone implements are often found. *The number and nature of these* may be judged from the descriptions which I have given of the deposits at Hakodate and Otaru." (The italics are mine.)

We now turn to his description of the Otaru shell heaps, and find the following:

"In two visits to the place, entailing about six hours actual work, at which I was assisted by two coolies and about a dozen children, I made the following collection:" and this collection embraced one hundred and thirty-five arrow-heads, three scrapers, one awl, nine axes, one grinding stone and from three to four hundred obsidian flakes. Having also collected in the Otaru shell heaps, assisted by students, coolies and children, the yield of stone implements was quite as great.

It would be difficult to compute the number of hours actually spent in collecting in the Omori mounds, for a very great number of visits have been made to them in company with a large corps of students and assistants, and yet the entire yield was but eight rude stone implements, which have been figured in my memoir.

In other words, Prof. Milne, with assistants, collects from the Otaru mounds, in six hours time, one hundred and fifty-two stone implements, not counting hundreds of obsidian flakes. I with my assistants, in a large number of visits to the Omori mounds,

entailing perhaps five hundred hours work, have secured only eight rude stone implements!

Prof. Milne, therefore, stands accused of gross misrepresentation, to use no harsher term, for had he collected in the Omori mounds, or had he examined the collections at the University of Tokio, indeed had he taken the slightest pains to ascertain the truth in regard to the matter, he would have seen the wide difference in the number and character of the implements collected in the two places.

Judging from "the spirit of truth" which animated Mr. Dickins in the preparation of his article, it is no wonder he prefers such an authority to that of the "Salem Zoölogist," as he courteously designates the writer.

The above passages are sufficient to show the general character of this remarkable production. There is one portion of Prof. Milne's paper that is a valuable addition to our knowledge of the early people of Japan, and that portion, significantly enough, has been extracted from a recent work written by Mr. Kurokawa Mayori, for the translation and revision of which Prof. Milne has to thank the accomplished scholar, Ernest Satow!

We turn with relief from this paper to a work published by Henry von Siebold, from the press of M. Levy & Co., Yokohama. Mr. Siebold's work in quarto contains twenty-two pages of letter press, and is illustrated by twelve excellent photographic plates, crowded with figures of stone implements, stone ornaments and a few fragments of pottery. These will be of great interest to archæologists, and much credit is due Mr. Siebold for the manner and matter of his book. In short chapters he treats of stone implements and stone weapons, Japanese graves, Japanese caves, Japanese ancient pottery, Japanese shell heaps, stone ornaments and bronze objects, and tsuchi mug.o or clay figures.

Many interesting facts are given under these various heads, and his work is an important contribution to the scanty knowledge we possess of the stone implements of Japan.

There are some criticisms to be made, however, and the first one is, that in his pages he does not give thanks to the numerous Japanese friends who have loaned or given him material to illustrate his work, and who have, in various ways, aided him in his researches. This marked omission is certainly one of ingratitude which hardly becomes a foreigner who is admitted to many of these treasures through the courtesy of the Japanese government. This omission becomes all the more glaring in a land where politeness and gratitude are universal characteristics of its people.

In mentioning localities Mr. Siebold is not explicit enough. It is not sufficient to speak of caves in the Province of Musashi, for Musashi is a large province and covers a great deal of ground. He probably refers to the caves at Kabutoyama in this case, but there is no indication of this in his work. The marked absence

of these references, in many cases, is a serious fault in a work of this nature.

Mr. Siebold makes a ludicrous blunder in the following statement: "The shell heaps themselves consist, as is likewise the case with the Kœkkenmœdding of Europe and other parts of the globe, of the *Eburna!*" Will Mr. Siebold kindly inform his readers in what shell heaps of Denmark, Norway, Sweden, Great Britain, Spain, France, Portugal, North and South America, either on the east or west coasts, a single shell of Eburna has ever been found? Mr. Siebold has unfortunately copied his molluscan information (without credit being given) from a little paper of mine in the *Popular Science Monthly*. Being in Japan when this paper was printed, it was impossible for me to correct proof, and a printer's blunder which ran two genera together, as follows, "Pecten Cardium," Mr. Siebold reproduces this blunder with remarkable accuracy, and at the same time mixes things in a most unaccountable manner, by scattering the genus Eburna all over the world!

A little attention in quoting from other contributions might have saved him some mortification in this case.

Mr. Siebold in his impatience to prove the Aino origin of all the shell heaps in Japan, is lead into some curious processes of reasoning. For example, a curious comma-shaped stone, known as a magatama, is widely scattered throughout Japan and is regarded by the Japanese as having a high antiquity. The absence of this object in the shell heaps leads Mr. Siebold into the following extraordinary mode of reasoning. He says, "It would be scarcely possible to expect to discover among these rude stone implements which these shell heaps have produced, such an artificial ornament as a magatama, especially as the shell heaps themselves were only used as receptacles for useless and valueless articles. I think, therefore, that the fact of the magatama not being found is, on the contrary, proof that the shell heaps are of Aino origin." Comment on such reasoning is unnecessary.

Mr. Siebold states that in only one deposit has the evidences of cannibalism been found. It will interest him to know that in the Tokio deposit, in the deposits of Okadaira as observed by Mr. Sasaki, and in the Higo deposits as observed by me, the most unquestionable evidences of cannibalism occur. Mr. Siebold can hardly accept my evidences of cannibalism, but if they point that way he is ready to show that, though the Ainos are gentle and mild in manner now, it was not so formerly, and that they might have been cannibals, and he offers, in the absence of necessary testimony, that the Japanese annalists would have left unrecorded customs and practices, which would have thrown discredit on their race. This is a novel idea.

The question is simply, were the Ainos cannibals? not, were the Japanese cannibals. Mr. Siebold calls the shell heaps Aino

in their origin. Since the Japanese had fierce wars with the Ainos it would be past believing that they—bitter enemies as they were of the Ainos—would refrain from any feeling of delicacy in fastening every possible stigma, in reporting every possible crime about them.

The Ainos were looked upon as debased, as having an animal origin; what more probable than that every hideous feature of their life be recorded and perpetuated?

This important evidence being wanting, Mr. Siebold tries to make out that the Japanese were cannibals. Does he do this on the strength of their own historians or Chinese chroniclers? No, but on the testimony of Marco Polo! He who found in Japan temples roofed and paved with massive gold, who saw quantities of precious stones, who describes an invasion and storming of a city, the garrison put to death, all excepting eight, who by the efficacy of a charm introduced between the skin and the flesh of the right arm which rendered them proof against sharp swords, either to being killed or even wounded, and so they had to be beaten to death with wooden clubs!

In the face of the records we have preserved to us by the Japanese annalists, of the etiquette at the table, the dishes used at their feasts and offerings, and later still the development and institution of the refined and delicate ceremony of tea drinking, the *cha-no-yu*, not to speak of the persistence of their religious prejudice against the eating of flesh, is it possible that Mr. Siebold can really give credence to the following circumstantial account of Marco Polo. This extraordinary writer says, "that these people on capturing an enemy that was not ransomed, invited to their house all their relations and friends, and putting the prisoner to death, dress and eat the body in a convivial manner," etc., etc.

With these few criticisms, Mr. Siebold's work must be looked upon as a most excellent contribution to a knowledge of the archæology of Japan.—*E. S. Morse.*

Balfour's Comparative Embryology.[1]—Only within a year or two, owing to the rapid advances made in our knowledge of the embryology of the invertebrate animals, could this book have been prepared. It comprises a body of facts and, in the main, probably sound generalizations, which afford the student the only starting point for studies of this sort. The author has brought to his task much experience in the embryology both of vertebrates and invertebrates, and this knowledge, with wide reading and good critical powers, have rendered the book a reliable, standard authority. As such it is most useful and timely.

The first volume is confined to the many-celled invertebrate animals, beginning with the sponges and ending with the Echino-

[1] *A Treatise on Comparative Embryology.* By Francis M. Balfour, F.R.S. In two volumes, Vol. I. London, Macmillan & Co., 1880. 8vo, pp. 492, xxii. $4.50.

derms; the Protozoa not being considered. The author has evidently adopted Lankester's classification, as the Tunicata are not referred to in this volume, and will, undoubtedly, be taken up in the vertebrate volume.

The introduction treats of the development of the ovum and spermatozoön, the maturation and impregnation of the ovum, and its mode of segmentation. These subjects are treated in a clear way, with an abundance of illustration, and this portion will be found as useful as any part of the book, since the phenomena have been traced by but a few and are rather difficult to comprehend.

The introduction to systematic embryology refers to the mode of origin of the germinal layers, and the gastrula, both by invagination and by delamination, the figures very clearly showing these different modes of development of the germinal layers and primitive digestive cavity. We observe that Mr. Balfour uses the convenient terms morula and gastrula to express the two earlier stages in the life history of most animals, though he is unable to perceive a true gastrula condition in the Tracheata.

The remainder of the work is devoted to special accounts of the mode of development of such types of the different classes as have been studied. These include the Dicyemidæ and Orthonectidæ, Porifera, Cœlenterata, Platyelminthes, Rotifera, Mollusca, Polyzoa, Brachiopoda, Chætopoda, Discophora, Gephyrea, with references to the aberrant types of Chætognatha, etc., Nematelminthes, ending with the Tracheata, Crustacea, Pœcilopoda, Echinodermata and Enteropneusta, in the order here given. This order represents the author's views as to the classification, or what is but another name for it, the phylogeny of the invertebrates. We are gratified to see that the author assigns the sponges to a group by themselves, while the Mollusca have the same rank assigned to them as to the Polyzoa or Brachiopoda. We scarcely see why the Echinoderms are placed so far away from the Cœlenterates and worms.

At the end of nearly every chapter, after treating of the individual development, that of the organs is discussed, and finally, as in that on the insects (Tracheata), we are treated to a rehearsal of the general mode of formation of the layers and embryonic envelopes, with a full bibliography. As regards the latter it would be much more convenient to the student, especially the beginner, if the works had been cited in the order of publication, so as to induce one to study the history of the literature. After treating of the Tracheata and Crustacea, and Pœcilopoda, Pycnogonida, Pentastomida and Tardigrada, an excellent summary of Arthropodan development is given.

The theoretical portion relating to phylogeny is kept apart, and is discussed in a generally conservative and judicious way; the bearings of palæontology, though of primary importance as

checking too free interpretation of purely embryological processes, are not discussed. In the introduction the credit of the correlation of the development of the individual and the class to which it belongs, should have been given to Agassiz and to Milne-Edwards, however much it has been extended and modified by later evolutionists. We find little to criticise in the author's general views. The illustrations, where originally prepared for the work, are nearly faultless, with two or three exceptions.

THE ODONTORNITHES, OR BIRDS WITH TEETH.[1]—The present memoir presents the results obtained by Prof. Marsh from the study of the remains of this interesting group, procured by him during the last ten years. It is generally known that the specimens which represent the *Odontornithes* have only been found in America in the Niobrara Cretaceous, or No. 3 of Meek and Hayden, and within the geographical limits of the State of Kansas. Prof. Marsh's book sets forth principally the osteology of four species of the group, viz: *Hesperornis regalis, Apatornis celer, Ichthyornis dispar* and *Ichthyornis victor*, all discovered and named by himself. This work appears to have been well done, and it is worthily supplemented by thirty-four good lithographic plates. The conclusions of the author respecting the affinities of the genera of which he treats, are fully and clearly set forth. His discussion of the probable phylogenetic relations of *Hesperornis* are especially interesting. He shows that the modern affinities of this genus are with the Struthionoid types, while those of *Ichthyornis* and its allies are remotely to the *Longipennes*. He includes *Archæopteryx* in the same primary division. Thus constituted the *Odontornithes* are a group "homologous" with a part (perhaps all) of the remainder of the class Aves, and the two great divisions thus formed embrace corresponding or "heterologous" subgroups. In his discussions the author adopts the theory of the production of modification of structure by use, a doctrine first fully formulated in an essay in this journal.[2]

A supplement to the chapters above mentioned includes a synopsis of all the species of birds hitherto found in the Cretaceous formations of North America, twenty in number, all named by the author. We should like to have seen introduced here some clear descriptions of several of the genera named by Prof. Marsh, but whose characters we are yet unacquainted with. Some reference to the first discovery of birds with biconcave vertebræ in England by Seeley, in 1870,[3] would also have been in place. Mention of the extent and character of the services for which Mr. Oscar Harger is thanked in the introduction, would also have been proper.

[1] *The Odontornithes, or Birds with Teeth.* By O. C. MARSH. Memoirs of the Peabody Museum of Yale College, Vol. I, 1880. 4to, pp. 200.

[2] 1871, p. 603. Proceed. Amer. Philos. Soc., 1871, 253.

[3] *Annals Magaz. Nat. Hist.*, p. 129.

THOMAS' NOXIOUS INSECTS OF ILLINOIS.[1]—This report contains chapters on the insects affecting the cabbage, with a brief account of the parasites of domestic animals, and closes with an essay on the classification of the Acrididæ, or that family of locusts of which the Rocky Mountain pest is the type. The portion on cabbage insects contains considerable new matter. It is to be hoped that the State will furnish more original illustrations and better paper and press-work for subsequent reports, as these publications are of great value to the people. There are less typographical errors in this than in the two previous reports.

TRANSACTIONS OF THE ENTOMOLOGICAL SOCIETY OF LONDON FOR 1879.—This volume is rather thinner than its precursors, and while scarcely as important as usual may give a fair idea of the conditions and doings of the chief entomological society of Great Britain; indeed it stands nearly alone, for what other associations of a like nature there may be, are local and inconsiderable. There are twenty-five memoirs filling only 346 pages, so that the papers are, in most cases, quite brief; of this number twenty are descriptive, most of them purely so, and a few are simply faunal lists, mostly of exotic insects, and prepared by the officers of the British Museum.

Those more general in their nature and of interest to our readers, we will notice more at length. Eleanor A. Ormerod contributes some brief observations of the effects of low temperatures on larvæ; it appears that during the unusual cold of last winter in England, the insects were frozen, but eventually thawed out and were not seriously affected; what is said is confirmatory of what has been previously observed. In Dr. Fritz Müller's notes on the cases of some South Brazilian Trichoptera, or caddis flies, he describes those of *Rhyacophylax*, "the most curious of all our Hydropsychidæ." The cases themselves are rather rude canals covered with irregularly interwoven vegetable fibers, but at its mouth end each case has a large funnel-shaped veranda covered with a very beautiful silken net. The larvæ live in the rapids of various rivulets, and the entrance of the veranda is invariably directed towards the upper part of the rivulet, so as to intercept any eatable things brought down by the water."

In his morphological notes bearing on the origin of insects, Mr. J. Wood-Mason, of Calcutta, discusses certain points in the morphology of insects. He labors to prove that the antennæ of Machilis are homologues of the "antennæ (III) proper" of Crustacea, on the ground that he finds a process on the peduncle or base of the antennæ, which he thinks may represent the second or smaller branch of the antennæ of the Crustacea; especially as he finds a movable appendage present in Lepisma, and a large coni-

[1] *Ninth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois.* By CYRUS THOMAS, Ph.D., State Entomologist. Springfield, 1880. 8vo. pp. 142.

cal process in Blatta. He compares these structures with the second branch of the bifid antennæ of Pauropus. We may add that in certain coleopterous larvæ there are similar movable processes. These may be found to exist in other low or larval insects; but while interesting and suggestive, we scarcely see the need of going so far as to homologize them with the bi-flagellate antennæ of the Crustacea. These attempts are due to the hypothesis that the insects have been derived from the Crustacea, instead of what has seemed to us the better grounded view that the two classes have independently arisen from the worms, and also it is forcing nature into a straight jacket to attempt to institute too close homologies between the members of two classes.

Mr. Mason next shows that the mandibles of Machilis are articulated to the head just as in the chilognathous myriopods, though he adds that the joints are not movable. We have found what we suppose to be less distinct traces of an articulation in the mandible of Campodea. He concludes that the mandibles of the cockroaches are compound structures, "each made up of three (or four) such joints as are to be seen in Machilis."

Our author then asks, "Are the mandibles of insects and myriapods, like the jaws of Peripatus, modifications of walking legs?" He answers the query in the negative, and his reasons for his conclusion are apparently due to the influence of the hypothesis that insects are derived from Crustacea and not first hand from the worms. He judges that the mandibles of the higher Thysanura and the cockroaches as well as the myriopods "have resulted from the direct modification of such a biramous appendage as is seen in the earliest (nauplius) condition of many crustaceans." Embryology shows conclusively that the mandibles and in fact all the appendages of the head of both Crustacea and insects arise in the same manner and have the same form as the thoracic appendages. Would this not indicate that both arose from worms in which the rami and tentacles are obviously identical in form, and but slightly differentiated in function; and that the two classes followed distinct developmental paths, one with limbs adapted for swimming, as in the nauplius, with limbs all alike and no head differentiated from the rest of the body; while the terrestrial ancestor of the insects at once assumed what we have called the Leptus condition, having a head separate from the rest of the body, with biting appendages as distinguished from the walking limbs of the rest of the body? It seems to us that this is the broader, more tenable view. If we give ourselves up to too isolated, analytical views in animal morphology we shall be forever wandering, drawn hither and thither by false lights, when we should be guided by broad principles, of general application—but we do not wish to sit in judgment on the opinions of a most excellent observer.

Another point of interest studied by Mr. Mason is the nature

of "the abdominal appendages, which, in Machilis, are movably articulated to the hinder margin of the sterna of the eight antepenultimate somites, a pair to each somite." These as well as similar ones in Scolopendrella, he compares to the exopodite of Decapod Crustacea, notably Peneus, and thinks this an additional argument for the crustacean origin of insects. Now while Mr. Mason has pointed out some interesting points of resemblance between the Crustacea and insects, we do not think that these crustacean features have been derived from the Crustacea; but that they have independently arisen in the ancestral forms of each class. It will be interesting to follow up Mr. Mason's "suspicion that the limbs of myriopods are not strictly homologous with those of insects, but that they correspond with the rudimentary appendages of Machilis, and are consequently exopodites, the appendages of the legs in Scolopendrella representing the legs of insects, which would appear to be endopodites." This may or may not be the case, but we should not desire to fall into the error of drawing too close homologies between two sub-classes like the hexapodous and myriopodous Tracheata (insects).

Finally, our author, after considering the remarkable difference in the position of the genital openings exhibited by the different groups, and very generally by the opposite sexes of Arthropoda, believes this is "intelligible on the hypothesis that all the members of the sub-kingdom have descended from some worm-like creature, provided in every somite of its body with a pair of segmental organs or nephridia, and that different pairs of these organs have, in different descendants of this hypothetical ancestor, been connected in the genital aperture and ducts."

In a paper on the affinity of the genus Polyctenes, Mr. C. O. Waterhouse conclusively proves, by a winged form closely allied to the wingless Polyctenes, that this insect belongs near the Hippoboscidæ, or horse-ticks and bird-flies. In a brief paper on the natural affinities of the Lepidoptera hitherto referred to the genus Acronycta, M. A. G. Butler removes several of the species to the Arctiidæ, a subdivision of Bombycid moths. Our own observations on the structure of the head as well as the general form of the body, made several years ago, lead us to think that such a removal is quite unwarranted, and that the interesting analogies to the Bombycids are superficial, and not fundamental.

RECENT BOOKS AND PAMPHLETS.—Description of four new species of Silurian Fossils. By S. A. Miller. (From Jour. Cin. Soc. Nat. Hist., July, 1880.) 8vo, pp. 5, Pl. 1, 1880. From the author.

The Three Climates of Geology. By C. B. Warring. (From Penn Monthly, June, 1880.) 8vo, pp. 36. From the author.

Contributions to Invertebrate Palæontology, Nos. 2–8. By Dr. C. A. White. (Ext. from the Twelfth Annual Report of U. S. Geolog. Surv., 1878.) 8vo, pp. 171, Pls. 42. From the author.

The Hessian Fly. By A. S. Packard. (Bull. No. 4, U. S. Ent. Com.) 8vo, pp. 43, Pls. 2, Map 1. From the author.

Etude sur les Grenouilles Rousses Ranæ Temporariæ et Descriptions d'Espéces Nouvelles ou Inconnues. Par G. A. Boulenger. (Ext. Bull. Soc. Zool. de France pour 1879.) 8vo, pp. 38. From the author.

The Plowshare. By Henry M. Parkhurst. Vol. XXXII, No. 3. 16mo, July, 1880. From the editor.

On the Zoölogical Position of Texas. By Edw. D. Cope. (From Bull. U. S. Nat. Museum.) 8vo, pp. 51, August 1st, 1880. From the author.

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GENERAL NOTES.

BOTANY.

CONTRIVANCES FOR CROSS-FERTILIZATION IN THE RANUNCULACEÆ.—In Ranunculus the stamens near the honey pores are adnate-extrorse to scatter pollen upon insects as they take honey. The receptacle is elongated to elevate the ovaries and furnish a firm, conspicuous platform, so that insects will first alight upon them. An elongation of the styles simply would not accomplish the purpose.

In Aquilegia the pollen is very rarely if ever discharged till the anthers are beyond the stigmas. As the flowers are pendant this prevents its falling upon the stigmas even if they were prepared to receive it. The spurred petals are placed on all sides of the stamens so that in passing from spur to spur the stamens are almost sure to be brushed. After the stamens have all discharged, the styles then elongate and the feathery stigmas open and curve sidewise so as to bring themselves before the mouths of the petals and at about the same distance at which the anthers were in the staminate stage of the flower.

I have seen humming birds visit the columbines and they seem especially adapted to fertilize them.

In Delphinium one sepal is spurred and two petals are utilized to make the stiff rim for its mouth. Two other petals, or in some species projections from the two already mentioned, serve as a kind of apron to protect the stamens and pistils till each is fully mature. The stamens are first to become so; at which time, by an elongation and bending of the filaments, each anther is brought from under the petals and placed before the mouth of the spur. After discharging pollen, each is withdrawn by a contrary movement of the filament. In a similar way, after the stamens are through, the stigmas are brought into the same position.

In both Aquilegia and Delphinium the outer stamens mature first, the inner meanwhile forming a sheath for covering the pistils. The degrees of complexity in these flowers and the intermediate position of Aquilegia need only to be mentioned to be readily

seen. Delphinium may be considered the highest and latest developed type of the three, and *D. consolida* would seem to be of later origin than *D. tricome* and others. Aconitum may be a stage between Delphinium and Aquilegia.

The history of these different structures, the spur, the automatic filaments, etc., offers a very attractive field of investigation. The Ranunculaceæ, on account of their wide distribution, great numbers and variety of forms, seem especially favorable for studying this branch of vital dynamics.—*J. E. Todd, Tabor College, Iowa.*

Botanical Notes.—The process of fertilization of the tulip by Halictus bees is described in the *American Entomologist* for June, by W. H. Patton, who questions whether the nectar is poisonous, as stated in Miss Stavely's "British Insects."——The fertilization of *Cobœa penduliflora* of South America is effected, says A. Ernst, in *Nature*, by large Sphinx moths, and no flower gave a fruit without having its stigmata pollenized by crossing, self-fertilization being therefore excluded; he also confirms Bonnier's statement that the nectar is of no direct advantage to the plant. ——In this connection may be mentioned the excellent treatise of Mr. William Trelease on nectar, its nature, occurrence and uses, which appears in the report on cotton insects issued by the Agricultural Department, and which we notice in another place. ——Dr. H. Müller continues in *Kosmos* (IV, Heft 4, July, 1880) his series of papers on the relation of Alpine flowers to the theory of the production of flowers.——Dr. Eberth describes a Bacillus which he claims caused the death of a badger, the bacilli appearing to actively excite inflammation, the animal dying after a few days' illness, showing no other symptoms than decrease of appetite and weakness. The disease germs appeared in the liver, sections of the capillaries being crowded with them. ——Mr. W. T. T. Dyer contributes to Trimen's *Journal of Botany* an article on Lattakia tobacco, which owes its flavor to being smoked with the wood of an oak, *Quercus ruber* var.

ZOOLOGY.[1]

A new Harvesting Ant.—We have a true harvesting ant, it appears, at our very doors. In Vineland they are on every street, in every yard. At Island Heights, Ocean Grove, also, and Asbury Park, they are very numerous. A very large colony may be seen on the lawn opposite the Arlington House, at the former place. I have not looked for them farther north, but have no doubt they will be found generally in our latitude.

It is a small ant, the worker being about a line long. It is of a red-

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

dish-brown color. The head is rather large. The head of the soldier ant of this family is a marvel for size, being many times larger than the abdomen. It is not above working when necessary, but is not commonly seen on the surface. It appears to rule its community, and certainly furnishes the brains of the family, in bulk, at least. In battle it is a very Ajax. It is a ferocious, murderous warrior. A war between them is a terrible thing in a small way. They cut each other in two and yet continue to fight. I have on my table, now, a pair whose abdomens have been cut off just back of the posterior pair of legs, so that they run about without any apparent embarrassment. A few moments since I placed them near each other. They gave every sign of undiminished rage and courage and flew at each other as if in the best condition. And, as I write, one of these bodiless heads is actually walking off with the other. These unconquerable contestants were taken from formicaries about fifty feet apart. Under a good objective these heads exhibit the characteristic striæ of *Pogonomyrmex crudelis* Forel, as I am informed by Mrs. Treat, an excellent authority.

The males and females are several times larger than the workers. I should think the female would outweigh forty of the little fellows. Though bothered with wings, the females are at this moment diligently excavating, in a small artificial formicary in which, as yet, I have placed no soldiers, but workers and females only. I have made many interesting notes concerning these strangers, which I may hereafter give to the public. I have sent specimens to Dr. Forel, who informs me that they belong to a variety of *Pheidole pennsylvanica.*

The rejected husks of seed carried out and piled up by their doorways first called my attention to them and revealed to me their character. It would seem that they do their house cleaning in the latter part of June, to be ready for harvesting the new crop of grass and other seed now ripening. Here and there, however, a careful eye may detect signs of some later work in husks just brought from below. Grass, clover, sorrel or other seed put near them will be seized and carried below with evident eagerness.

They have a violent antipathy to the little yellow ant—the pest of the pantry—a fact which may be used in recognizing them. Place a piece of cake full of the yellow ones near any formicary supposed to belong to the harvester and, if the supposition is correct, you will have the pleasure of seeing the big-headed soldiers rushing out with gaping mandibles eager to crush the tiny foe, and prevent the threatened invasion.—*Rev. G. K. Morris, Vineland, N. J.*

Budding in free Medusæ.—In a review of Packard's Zoölogy by J. W. F. in the August number of the Naturalist, the following passage occurs: "On page 60 the author says, 'Budding

occurs in the medusa of *Sarsia prolifera*, the only example known of budding in free medusæ.' Alex. Agassiz has shown that budding occurs in the free medusa of *Lizzia grata*, also in *Dysmorphosa fulgurans* and in *Hybocodon prolifer*. These medusæ are all found in New England waters. Many similar cases have been described in Mediterranean genera."

By an odd chance I had under the microscope, at the time I read this article, a medusa, a Willia, which must be added to this list, as it produces medusæ by budding from the base of the manubrium. During the latter part of July I took with the dipping net, in Beaufort Inlet, N. C., a great number of specimens of *Willia ornata* (McCr.) at various stages of growth; they agreed perfectly with Mr. Alex. Agassiz's description and figures, and show that the latter author was correct in referring two specimens to the same species as the single specimen found by McCrady at Charleston. With them was a single specimen of another form, which at first appeared to belong to a second species of Willia. Although it was larger than those of the common form in which the reproductive organs were fully developed, these were entirely wanting; there was a slight difference in the outline of the bell; the tentacles were only eight in number, short and thick, and usually carried coiled up under the edge of the bell. The tubes with the clusters of lasso cells, contained only a single cluster each, instead of two or three clusters, as in the ordinary form.

On the inner surface of the bell, where the radiating chymiferous tubes joined the manubrium, and therefore nearly in the position which is usually occupied by the four reproductive organs, four long branchial stolons hung down into the cavity of the bell, and the tip of each branch terminated in a medusa bud, with four rudimentary tentacles.

The general resemblance of this form to *W. ornata*, the occurrence of the two together, and the absence of reproductive organs, seems to indicate that we have, not a new species, but an asexual form of *W. ornata*, which gives rise to the sexual medusæ by budding, so that we have an alternation of generations of free medusæ.

The specimen soon died in confinement, and as stormy weather set in that night I got no more of them, hence the question whether the two forms belong to the same species must therefore be left in doubt for the present.—*W. K. Brooks, Beaufort, N. C.*

English Sparrows refusing to eat Worms.—One can hardly blame either bird or beast for not liking to eat caterpillars and canker-worms, but when it is claimed that that is what the English sparrow is for, it is well to keep the facts of the case before the people, as a great many persons are doing. I observed a "sin of omission" on their part here in Washington, which I do not remember to have seen in print. After every rain the

common earth-worm comes out of the ground in great numbers, and upon the walks through the Smithsonian grounds, for example, where sparrows are abundant, they remain until they are dried to a crisp in the sun or crushed by the feet of pedestrians; and the sparrows are meantime rumaging the horse droppings in the street for, to them, more acceptable food. If they are really an insectivorous bird they surely ought not to refuse earth-worms, which are favorite food with such birds.—*C. A. White.*

How Insects resist Cold.—The cocoon surrounding an insect affords little protection, relatively, to temperature. Where a pupa resists congelation, it does so by virtue of a continuous and considerable liberation of heat. Whence is this production? According to Dr. Jousset de Bellesme *(Les Mondes)*, it is very probably due to the organic transformations taking place in the pupa. Without going so far as to say (with some naturalists), that all the organs are destroyed to be built upon another plan, it is certain (speaking only of the muscular system) that there is a disappearance of certain muscles that have served for the larvæ, and formation of new ones, to be used by the perfect insect. Such work could not be done without a reciprocal liberation and consumption of heat, which would compensate one another if the reconstructed muscles were the equivalent of those destroyed. But the muscular system of the larva is much more considerable than that of the perfect insect, hence all the heat rendered disposable by destruction of the old muscles is not utilized in construction of the new ones. Further, uric acid and its derivatives are found abundant in the insect which has been metamorphosed, and this is another proof of the existence of active combustions during the pupal period. It is then apparently, to these organized chemical phenomena that we must attribute the facility with which insects, in the course of transformation, bear very prolonged depressions of temperature.

"Mimicry" in Snakes.—In the Naturalist for September, the question is asked, "Does the fox-snake 'mimic' the rattlesnake?" This recalls an experience of mine that occurred several years ago, when collecting plants in the vicinity of Panola, Miss. A snake of an unknown kind running along in the low grass was pursued to some rails that lay in a loose pile on the ground where it had fled for safety. By means of a stick of sufficient length, after finding it, I held it fast to the side of a rail, when I was surprised and startled by a buzzing sound from its tail. The first thought was that I had a rattlesnake, but a glance at the tail and the color of the skin at once disproved this. Feeling safe from being bitten, the hold was kept, and the phenomenon observed. The tail, vertically flattened either naturally or for the occasion, was thrown into rapid vibrations from side to side. The snake was very angry at being held, and I thought this its

mode of showing its spite. The sound seemed hardly as acute as that made by the rattlesnake, but may have been somewhat modified on account of the beating of the tail against a rail, as it did from its position. It was, however, a close enough imitation to cause one, on hearing it, to get out of the way of harm. My description of the way of producing the sound would be in almost exactly the same terms as those used by Mr. King, though, if I remember rightly, it was more continuous, still it was not without interruptions. On loosing my hold to get a better chance to kill the snake, being uninjured it glided rapidly away, and escaped among the grass and bushes, and, as I was not in search of that kind of specimens, no further pursuit was made. I did not know the species, but from its slender form, dark color, and rapid running, should think it a Coluber, or one nearly allied to that genus. Its length was about five feet.—*E. J. Hill, Englewood, Ill.*

Notes on the Mammals of Southern Utah.—We have grizzly bears in small numbers in the mountains, although I have never been so fortunate (?) as to meet with one, but I have known of two being killed in the neighborhood of Ranch. I spent much of my time on the Pauns-a-gunt Plateau this summer, from June to November, and during the whole time I did not see any sign that indicated that bear of any kind were there or had been for a long time. The Indians say that they never find them there but that they are abundant on the Mar-ka-gunt Plateau. Black and cinnamon bears are reported, but they are very rare; I have never seen even a pelt of one that was killed in this locality. Of deer we have but one species, as far as I can learn, that is the mule deer. They frequent the high plateaus in the summer time when they kid in June and July; in October they come down upon the benches about the water courses where there are oaks, and remain until after the rainy season, when they go back upon the mountains, if the snows are not too deep; when this is the case they range on the sides of the mountains and at the foot of them on the broken hills. They are not as wary nor as fleet of foot as the fallow deer, as they will stand with head down evidently to hide their long ears in a bunch of brush, and allow the hunter to pass within a few steps of them without their running or, in fact, stirring. They seem to understand that their safety depends upon, what many of this world's folks have not learned to do, *i.e.*, keeping still. The Indians that hunt them at fawning time, tell me that they seldom find a doe with two young. They change their color in the fall of the year from a dirty clay color to a gray or ashen color with yellow legs; they have the power of erecting their hair when excited, and then are almost black. They are hard fighters; I have one, a pet doe, five months old, that whips any dog that comes about the place, using her fore legs as clubs to strike with, and when this is not efficacious jumping with all

four feet upon her enemy; the last stroke always does the work. I got sight of two animals last August on Pauns-a-gunt Plateau; they were blue in color, with horns like a goat, five others were seen on the same plateau; I do not know what they are nor do I know anything about their habits. On the same plateau are panthers and wild cats, with porcupines and badgers. Everywhere can be found that hen-roost robber the coyote; it will eat fowls, rabbits, crows, crickets, grasshoppers and almost anything else of animal kind, including yellow jackets. Nests of small animals, white bellied or ground mice, gophers, kangaroo rats, mountain rats with their large pop eyes and flat tail, are abundant.—*A. L. Siler, Ranch P. O., Utah.*

ICHTHYDIUM OCELLATUM.—I have found this singular Infusorian, first described by E. Metschnikoff, from German waters, in great abundance in a land-locked salt pool near Mobjack bay, New Point Comfort, Va. It was associated with vast numbers of another member of the same family, viz: *Coleps hirtus* Ehbg. There were also great numbers of a small Amœba present, together with a species of Difflugia, which appears to be *Arcella vulgaris*, with which a large holotrichous Infusorian, which I did not determine, was often literally stuffed. The supposed eyes of *Ichthydium ocellatum* did not appear as distinct to me as they are figured by Metschnikoff. The chitinous annulate œsophagus and the singular backward prolongation of it, which it is hard to believe is a true intestine with a proper wall, was clearly seen. The zoölogical position of these symmetric Infusoria, as they were called by Dujardin (*Gasterotricha* Metsch. and Class, *Nematorhyncha* of Huxley), still apparently remains to be settled.—*J. A. Ryder.*

ON THE COURSE OF THE INTESTINE IN THE OYSTER (OSTREA VIRGINIANA).—In investigating the anatomy of the American oyster, under the auspices of the Maryland Fish Commission, at St. Jeromes creek, Md., I find an arrangement of the intestine so remarkable that I will briefly describe it. The mouth is a wide opening between the upper median angles of the palpi; so wide indeed, that the animal can scarcely be said to have an œsophagus; immediately follows the stomach, which is seen to have very pronounced folds internally, with a generally transverse direction, but two of these which lie in a somewhat ventral position, are a pair of inward projecting lobes which are themselves lobulated. The intestine then follows an oblique course, downwards and backwards, when it makes a sharp bend returning beneath the floor of the pericardial space, passing obliquely upwards and forwards, somewhat to the right and dorsad of the stomach, when it crosses exactly over the mouth or very short gullet, passing downwards to the left side of the animal, alongside and a little to the lower side of the stomach, when it again turns upwards and passes

over the pericardial space to end in the rectum just over the middle of the adductor muscle. The liver, as is well known, dips into the folds of the walls of the stomach, but does not seem to follow the course of the intestine proper, which is provided internally with a curious pair of longitudinal and parallel folds, which project into the intestinal cavity and extend from the pyloric end to very near the anus. The presence of these folds, gives to the fœcal matters their singular appearance, which is not in the form of a cylinder as they leave the vent, but in the form of a tube with a part of one side removed. Tracing the course of the intestines by sections is not the proper way; they can be very easily dissected out for their entire length by means of the scissors and forceps.

The general likeness of this arrangement of the intestines to that of other Lamellibranchiates is apparent, but I was not prepared to find it return and cross over the mouth so very far forwards. Prof. Brooks[1] apparently believes the intestinal coils to lie behind the stomach and liver, which is not the case according to the foregoing observations, nor is the use of the words "coils" and "convoluted intestine" admissible, since there is but one complete turn of the canal upon itself.—*J. A. Ryder.*

Phosphorescence of very Young Fishes.—Whilst investigating the development of *Cybium maculatum* and *Parephippus faber*, or the bay mackerel and porgy, under the auspices of the United States Fish Commission, in Mobjack bay, Virginia, I found that the latter species, when three days old, was very decidedly phosphorescent at night when sudden impulses were imparted to the sea water in which they were swimming about, acting in this regard in relation to such sudden vibratory impulses the same as numerous species of marine animals, such as some worms, Medusæ, Polyps, Infusoria and many larval forms of Crustacea and other marine types which swim at the surface of the water at night. The presence of an extraordinary development of amœbaform cells over certain parts of the bodies of these little fishes, may be the cause of these phenomena. So striking is the resemblance of these migratory superficial amœba-like cells to some of the *Protoplasta*, that were it not that they lack a contractile vesicle they might readily be regarded as their homomorphs.

These cells, moreover, change their forms from time to time very considerably, but tend to aggregate in anastomosing clusters, a sort of syncytium over the oil-globule in the umbilical vesicle; over the ectoderm of the vesicle itself and on certain portions of the body and tail. They are very different from pigment corpuscles, which are also present.

Besides these cells a peculiar homogenously distributed reddish

[1] Development of the American Oyster (Biological Studies from the Laboratory of Johns Hopkins University, No. IV), pp. 9–10.

tinge is acquired by the membranes of the umbilical vesicles of the porgy on the third day, which is not due to the presence of blood globules.

To whichever of these structural causes, the phenomenon of organic phosphorescence is attributable in this special case, there seems to me to be little doubt that the prime element in the production of phosphorescence in the animal world in general, is some kind of sudden molecular disturbance or impulse, disturbing the equilibrium of the molecules of the living protoplasm involved, so as to produce a kind of motion which makes itself apparent as momentary emissions of light. I have no doubt that the phenomenon in Lampyris or the fire-fly, is connected with expiration and inspiration, and possibly in the Medusæ with the rhythmical contraction of the umbrella. The application of experimental methods to verify the above suggestions would be very easy.—*J. A. Ryder.*

Zoological Notes.—Mr. M. M. Hartog shows that the larvæ or zoëæ of cancer have, like the adult entomostraca, an anal respiration, the terminal part of the rectum being slightly dilated, and with a rhythmic contraction and expansion associated with the opening and closing of the vent.——Hybrids between males of Reeves's pheasant and hens of the common pheasant were exhibited at a recent meeting of the Zoölogical Society of London.——A honey ant with an immensely distended abdomen, like Myrmecocystus, has been discovered in Australia.——Reinfleisch claims to have demonstrated the origin of the red corpuscles of mammals; *i. e.*, the nucleus of the red-colored cell escapes and atrophies, while the body of the cell contracts and becomes the red corpuscle ——The influence of light on animals has been studied, according to the Journal of the Royal Microscopical Society, by Moleschott and Fubini. It increases the excretion of carbonic acid and the ingestion of oxygen; but this influence is not only effected through the eyes, but by the skin, for it is seen in eyeless animals.——Weismann has found that several ostracode Crustacea, especially Cypris, reproduce parthenogenetically.——At the meeting of the Linnæan Society of London, held June 17, Sir John Lubbock presented additional observations on the habits of ants, especially concerning their powers of communicating their ideas to each other; he confirms the prevalent notion that ants possess "something approaching language."

ANTHROPOLOGY.[1]

Maya Chronology.—The Proceedings of the American Antiquarian Society, No. 74, contains a paper by Mr. Philipp J. J. Valentini, on the Katunes of Maya history. The Katunes were a series of notable events that transpired from the time of the

[1] Edited by Prof. Otis T. Mason, Columbian College, Washington, D. C.

departure of the Mayas from their original home until their destruction. Don Juan Pio Perez, a learned Yucatecan, had found an old Maya manuscript containing this account, but failed to discover the author's name. From this precious document Mr. Valentini attempts to reconstruct the Maya chronology in the same manner that he deciphered the Mexican calendar stone. The results at which he arrives are as follows:

1. That the conquerors and settlers of the Yucatecan peninsula, as well as those of the Anahuac lakes, were joint participants in a correction of their national calendar about the year 290 B.C.

2. That about the year 137 A.D., when a total eclipse of the sun took place, the ancestors of both nations set out from their common fatherland, Tula, or Tulapan.

3. That about the year 231 A.D., both nations made their appearance on the coast of Central America, and succeeded in conquering a large portion of the peninsula.

German Anthropology.—The second number of *Correspondenz-Blatt* der deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte is taken up with a preliminary statement concerning an anthropological and prehistoric exhibition for Germany, which will take place in connection with their Anthropological Society in Berlin, in August of this year. In No. 3 we have an exemplification of what our German cousins accomplish by concentrating one's energies upon a single subject. Dr. H. Fischer, of Freiburg, who is the greatest living authority upon jade, jadeite, nephrite, chroromelanite and kindred material, gives us a detailed account of every specimen of implements made from these materials, and known to exist in public and private museums of Germany, Switzerland and Austria.

Venerable Archdeacon Kirby delivered a lecture before the Philological Society of London, Friday, April 30th, on the Cree language, and the use of the syllabic characters in teaching it to the natives.

Mr. J. B. Good has published at Victoria, British Columbia, a vocabulary and outlines of grammar of the *Nitlakapamuk*, or *Thompson tongue*, the language spoken by the Indians between Yale, Lilloet, Cache creek and Nicola lake, to which is added a phonetic Chimok dictionary, adapted for use in the province of British Columbia.

Report of the Peabody Museum.—It must be a source of unalloyed pleasure to our older archæologists to look back over the steady progress which a study weighed down at first with wild speculations has made toward becoming an exact science. Among the monuments erected to signalize this improvement and incite to increased activity, the Peabody Museum stands pre-eminent. The twelfth and thirteenth annual reports, constituting Nos. 3 and 4 of Vol. II, are quite up to the mark in the value of their origi-

nal papers. The report of Mr. Putnam, the curator, sums up the labors of Dr. Abbott, Mr. Schumacher, Mr. Gilman, Dr. Earl Flint, Dr. Edward Palmer, Mr. Curtis, Dr. Patrick, and of the immediate force of the institution. The list of contributions is followed by a series of papers, of which a brief sketch is appended.

Mr. Lucien Carr, who has thoroughly qualified himself for the task by studies abroad, gives measurements of 150 crania from California, in which the following characteristics are included: capacity, length, breadth height, index of breadth, index of height, width of frontal, length of face, length of nose, breadth of nose, basi-nasal length, basi-alveolar length, ptereon, nasal index, gnathic index, height of orbit, width of orbit, orbital index, zygomatic diameter.

Dr. C. C. Abbot continues his investigations upon the flint chips of New Jersey. Two kinds of workshops have been discovered, one near the natural sources of supply indicates that the Indians came indiscriminately, each to make points for himself; the other, that a few skilled workmen plied their handicraft. The other important discovery of Dr. Abbott is the existence of argillite points belonging to an earlier time than the same implements of flint-like mineral, and forming a connecting link between these latter and those found in the drift gravels of the river valley.

Mr. Paul Schumacher gives us the methods of making pottery and basket ware among the Kahweyahs, on the coast of California. The important points to notice are, the use of an oval dish for the potter's wheel, and the use of the bone needle in stitching basket ware.

The article of Mr. Elmer R. Reynolds on soapstone quarries has been noticed in another connection.

The Hon. Lewis H. Morgan having visited the Pueblos in 1878, studied closely the ruins of a stone structure on the Animas river in New Mexico, and presents his results in an illustrated paper. Mr. Morgan is quick to discern the connection of the environment with the kind and degree of progress which a people have made. To the presence of the peculiar adobe soil, the cleavable sandstone of the bluffs, and, to the climate, the ancient cliff and pueblo people are indebted for the material cause of their advancement. Mr. Morgan strenuously denies the knowledge of caustic lime mortar anywhere in aboriginal America; but admits that gypsum may have been used as a bond. While expressing his astonishment at the amount of skill exercised by a people so poorly furnished, the author does not fail to recognize the long and tedious miles intervening between their gradus and ours. At the close of the paper occurs this significant sentence, "That the original ancestors of the principal historic tribes of Mexico once inhabited the San Juan country is extremely probable, that the ancestors of the principal tribes of Yucatan and Central America owe their remote origin to the same region is equally probable.

And that the Mound Builders came originally from the same country is, with our present knowledge, at least a reasonable conclusion."

We may, without the least fear of exciting envy, give the first place of merit to the paper of Mr. Ad. F. Bandelier, on the "Social organization and government of the ancient Mexicans," occupying 142 pages of the report, and not falling below the author's communications on "The Art of War" and "The Tenure of Land" either in the importance of the subject or in the manner of treatment. All students of ancient Mexican sociology have felt the insecurity of Spanish chroniclers for two reasons. The most courtly and ceremonious people in the world could scarcely refrain from the use of such terms as "knight," "king," etc., when speaking of the Mexican rulers; and, secondly, every inducement existed to magnify the glory of their own deeds by exaggerating the numbers, valor, and culture of the Mexicans. This practice of embellishing, unfortunately has been perpetuated among modern writers of great genius. Mr. Bandelier, acknowledging what we have said above, and being profoundly impressed with the teachings of Mr. Morgan, has set himself the task of reconstructing the history of the ancient Mexican upon the systems of gentile organization contained in Morgan's "Ancient Society." The complicated nature of such a work necessarily determines the style of the communication; therefore, the great preponderance of notes over the text is partly justified. Long familiarity with ancient authorities and the coöperation of such distinguished Mexican scholars as Sr. Orozco y Berra and Sr. D. J. G. Icazbalceta, have specially fitted Mr. Bandelier for this difficult task. The special aim in the present member of the series is best told in the author's own words:

"There was, in aboriginal Mexico, neither state, nor nation, nor political society of any kind. We have found a population separated into tribes representing dialectical variations of speech, each tribe autonomous in matters of government, and occasionally forming confederacies for purposes of self-defence and conquest. Out of that confederacy, brought so prominently forward by the events of the Spanish conquest, we have selected on account of its military preëminence, one tribe—the ancient Mexicans—and we have shown that it was an organic body composed of twenty autonomous kins for purposes of mutual protection and subsistence. A social organization resting upon such a foundation must, of necessity, have been a democratic body. Indeed, we have found that each kin was governed by strictly elective officers, subject to removal at the pleasure of their constituents; that the twenty kins, for their mutual benefit had delegated their powers to transact business with outsiders to a council of the tribe, in which every kin was represented by one member, and consequently had the same voice and vote as any one of the others.

The execution of the decrees of this council was left to elective officers, whose power was limited to military command, and whom the tribe might depose at pleasure. With the exception of some inferior positions, these officers had not the power of appointing others to office, not even their assistants of high rank. The dignity of chief, so commonly transformed into hereditary nobility, has been found to have been merely a reward of merit, and carried with it no other prerogative than personal considerations and occasional indulgence in finery. Taking all our investitions we conclude *that the social organization and mode of government of the ancient Mexicans was a military democracy originally based upon communism in living.*"

THE AMERICAN ANTIQUARIAN.—The third number of Vol. II, contains the following papers, together with a large amount of interesting correspondence and editorial notes: The Mound Builders, by Stephen D. Peet; Brady's Leap, and other facts of Indian History, by J. P. Woodruff; Exploration of a Rock-Shelter in Summit Co., Ohio, by M. C. Read; Was LaSalle the Discoverer of the Mississippi river; Letter from Pierre Margry; The numeral adjectives in the Klamath Language of Southern Oregon, by Albert S. Gatschet; The Sign-Language of the Indians of the Upper Missouri, in 1832, by Colonel Garrick Mallery; Wampum Belts of the Six Nations, by Rev. W. M. Beauchamp. The first article is reproduced from the Proceedings of the "Congress of Americanists." Mr. Read's paper is a contribution to a little-worked portion of our anthropic area, but one that promises rich results. Pierre Margry holds that LaSalle discovered the Mississippi river, by way of the lakes, by Chicago, and the Illinois river, as far south as the 36th parallel, before 1676 (the date of Marquette's discovery). Mr. Gatschet's paper is an original communication of great merit, in which we find the numeral system of the Klamath Indians both laid down and explained. Col. Mallery gives us a segment of a great work which he is preparing under the auspices of Major Powell's Bureau of Ethnology, upon sign-language in general. Mr. Beauchamp is authority on wampum belts; and we have seen somewhere a set of drawings by this author giving the various designs represented on these belts.

ARCHÆOLOGY IN WISCONSIN.—Volume VIII of the Wisconsin Historical Collections, for the years 1877, 1878 and 1879, is a very important contribution to archæology. Before praising it too highly, we beg leave to caution the editors to read the proof of the next volume a little more closely, and to exclude the repetition of more than "thrice told tales," as on pages 148 and 149. The ancient copper-mines of Lake Superior are described by Mr. Jacob Houghton. On the south shore of Lake Superior the works of the ancient miners extend over a district of country comprising what is known as the Trap range, having a length of

150 miles through Keweenaw, Houghton, and Ontonagon counties, with a width varying from four to seven miles. They also wrought the copper deposits of the Trap range of Isle Royal, covering an area of about forty miles in length, by an average of five miles in width. The article by the Rev. Edmund F. Slafter, on prehistoric copper implements, treats the subject from an historical point of view. We drew attention to this paper on its first appearance in the *New England Historical and Genealogical Register*, for January, 1879. We are next treated to a *symposium* on copper-working—were the ancient copper-workers acquainted with the art of smelting copper? Mr. Draper opens the discussion, inclining slightly to the affirmative, and is followed by Mr. Fred. S. Perkins on the same side. The opposite view is advocated by Col. Charles Whittlesey and Doctor P. R. Hoy. It has occurred to us, as greenhorns, to ask some of our friends to try the effect of sound as a test. Make a mold of one of the implements supposed to have been cast. Take a cast copy, suspend it alongside of the original, by a wire, and strike them alternately with a rod of steel. A priori, if the original is cold hammered, it will be full of flakes and scales, and should give forth a duller sound than the cast copy. We are not strenuous advocates, however, of the "high priori" method. Indian pictography is now receiving a great deal of attention, and the Rev. Edward Brown has something to say about the Pictured Cave of La Crosse valley, near West Salem, Wis. On pages 188–194, Mr. Benjamin Sulté, of Ottowa, Canada, gives us a résumé of the labors of Jean Nicolet, in which the author affirms that "Nicolet must have traveled to the Mississippi, in the year 1634–5, from July to July, because that period is the only one during which we cannot find him on the shore of the St. Lawrence." The papers on the Rev. Eleazer Williams, by Gen. A. G. Ellis and Mr. Lyman C. Draper, pp. 322–352, are certainly interesting reading upon a very great conundrum. In this connection we may say that the Rev. J. P. McLean, of Hamilton, Ohio, will commence in the July number of the *Universalist Quarterly*, a series of three articles upon the study of American archæology. Mr. McLean is one of our most diligent workers in the West, and will, doubtless, present the subject in its latest phases.

Cliff-Dwellings in Southern Utah.—Mr. A. L. Siler has discovered at Malley's Nipple Ranch, near Pahreah, Kane county, Utah, remains of cliff-structures, which he describes as follows: The remains seem to have been the foundations of small huts built on ledges of red sandstone under overhanging cliffs. The walls were about six inches thick, made of thin, flat sandstone brought up from the valley below, and laid in adobe. The structures are divided into rooms about four feet square, leaving all the space between the building and the back of the cliff, usually about ten

feet, entirely free. Upon digging into one of the rooms, Mr. Siler found parched corn and rope in a good state of preservation.

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GEOLOGY AND PALÆONTOLOGY.

ON THE OCCURRENCE OF FOOTPRINTS OF DINORNIS AT POVERTY BAY, NEW ZEALAND.—When in Auckland, New Zealand, in 1875, my attention was drawn to some specimens of "Moa" footprints then in the museum of the Auckland Institute. After examining them carefully, I determined to procure some of these rare specimens for myself; with this intention I made a visit to the locality, which is on the right bank of the Taruheru river, near Gisborne, Poverty bay. Here I found what I so much desired to see in place, where hundreds and perhaps thousands of years ago, these great birds, sauntering in search of food, left their footprints indelibly impressed on the sand.

The portion of rocks in which the tracks are made (though many of them were nearly effaced by the action of the waves) was about fifteen to twenty feet in length, and from six to eight feet in width. Many of the impressions were close together, and with few exceptions were of nearly the same size. The tracks pointed in various directions, but some of them followed each other at regular intervals like successive tracks of the same bird, the strides were about nineteen to twenty inches from heel to heel. I noticed, however, some smaller tracks with strides of twelve and a-half to thirteen and a-half inches, which seem to accompany the larger tracks, as if they were made by a young bird, but these were too much effaced to be procured. At still another place I noticed some small tracks, such as might be made by a bird no bigger than a pigeon.

The tracks are in a soft sandstone which is being rapidly worn away by the action of the water and the weather, and the impressions are gradually disappearing. The sandstone is a mud deposit. We may imagine then, that these birds walked over the still wet sand, left by the receding of the river, a short time after it had subsided, leaving their tracks, and that afterwards the wind arose and drifted a coarser sand over them, as well as over the whole surface of the mud, to a depth of about half an inch.

The spot where the tracks are exposed to view is about at high water mark, and therefore much washed by the waves and so much effaced as to be scarcely worth removing. But by following up the surface of the sandstone stratum in which they occur, and judging by the direction they led, I split off numerous slabs of the overlying strata, in hopes of finding some better specimens, finally I traced them under a shallow bank, which was, perhaps, eight feet high, and was the lower part of a large plain; the upper portion is perhaps twenty-five to thirty feet high in some places, but whether these impressions ran under this to any great distance, it would be most impossible to tell unless a shaft was sunk on this plain. Running through the plain there are two rivers, viz: the Kopututea, which is formed by the confluence of the Waipaoa and the Arai, and occupies a middle position, rather towards the south-west of the plain; and the Taruheru, which falls into the sea at Poverty bay, at the north-eastern corner of the bay. At this point it was composed of sandy alluvium, containing shelly layers of recent species; below this occur successive strata of imperfectly solidified sandstone from four to six inches thick, and separated from each other by a thin layer of coarser sand and small pebbles, from a quarter to half an inch thick, and it is owing to this layer of comparatively loose sand that the impressions are so well preserved. At this point I dug out a slab two feet by three feet, of this soft sandstone, which is probably of Post-drift age. This rare specimen contains four fine footprints and part of the fifth; length of stride of these footprints is nineteen

inches; track from heel to toe, eight inches; from first claw to third claw, eight and a-half inches. The extreme depth of the heel of most of these were from one inch to one and a quarter below the ordinary surface of the rock. The stride is so short for such a large bird, that they must have been walking at a very leisurely pace, in fact all the other prints would indicate the same thing. These were found in about the fifth or sixth layer below the alluvial deposit referred to, and have a dip perhaps of about six degrees to southwards. But so far as could be ascertained, no "Moa" bones have ever been found, in this vicinity, imbedded in the recent rocks such as that in which the footprints occur.

Footprints of Dinornis (Moa).

The accompanying cuts will give a better idea of these, taken from specimens which I dug up myself, also showing *fac simile* casts made from the same specimens, showing the footprints in relief.

The original is now in the museum of the University of California, Berkeley.—*C. D. Voy.*

Geological Examinations in Texas.—After the middle of December of the past year, I examined the Little Wichita, along its whole course from its mouth to its remotest sources, together with all its right and left hand branches. After that I went to the Big Wichita, and traveled over all that region for about one hundred miles, from the mouth of the river and along its branches on both sides.

The time which I consumed in these regions amounted to over six months. The result of my investigations surpassed in scientific aspects all my expectations. I found not only many new plants and animals, consisting of petrified ferns, fishes and reptiles, but discovered a new extinct vegetable and animal world, hitherto wholly unknown in America. According to these petrifications, the whole region spoken of belongs to the transition period, and especially to the permian formation; both the lower and the upper are therein apparent.

In a mineralogical view I found there the following:

A. Rocks—sandstone as well as limestone is abundantly

diffused and eminently suited for building purposes, both on account of their hardness and stratification.

B. Metals—1. Iron ores; *a*, spar iron ore, or spherosiderite, pure and clayey; *b*, brown iron ore; *c*, yellow iron ore, as bean ore and limonite; *d*, hematite and ironglance, or silicate of iron.

2. Copper ores; *a*, malachite; copperglance; *c*, azurite.

3. Zinc ores; *a*, zincspath; *b*, zincblende.

4. Lead ore; as leadglance.

Among iron ores, the pure and clayey spherosiderite appears most frequently. The red and variegated clay strata, often 50 and 60 feet thick, are almost always overlaid with sandstone or limestone; all iron ores are contained in these clay deposits, and laid in compact masses, 2 inches to 2 feet thick, in more or less regular strata or in pockets.

Brown iron ore is seldom deposited as such in clay, but appears mostly from spherosiderite, exposed to the air and weather-beaten. On the other hand, yellow iron ore is found bound together in round pieces, from the size of a pea to that of a pigeon egg, abundant in some places, and is then called bean ore; or it forms hard, brown-red, heavy masses, containing very many animal remains, in which it is named limonite.

Through the influence of succeeding geological periods, the sandstone and limestone covering the clay strata were in some places destroyed; the soft clay laid bare was in the course of time by rain washed away, and thus there were produced the valleys, bluffs, hollows and ravines. The heavy masses of iron ores remained behind, and have by degrees so accumulated that there are stretches a mile wide on which hundreds of tons of iron ore can be gathered on the surface of one acre, without the aid of shovel or pick. When the spherosiderites are disintegrated and washed out they often acquire the appearance of slag, and have therefore formerly been taken for volcanic scoria.

The iron ore of the permian period of north-western Texas is diffused over a surface which extends over more than one hundred miles in length and over fifty miles in width. The outwashed and cleansed mass on the surface is so large that it would suffice to supply the whole United States with iron for ten years.

Copper ore is there often encountered, especially as malachite and copper glance; the latter is often mixed with coal, particularly when the petrified mass is formed from wood. However, I have now here seen these ores in inexhaustible quantities. I found them most abundant on the lands of the Texas Copper Mining and Manufacturing company. Zinc, in the form of zincspar and zincblende, exists in some places; there is also iron ore, especially spherosiderite, containing zinc. Lead is found sparingly injected in spherosiderite and very hard clay masses. I have nowhere

yet found coal deposits in the permian formation, but the permian is bordered on the whole south side by the genuine coal formation, which covers the latter in almost its entire extent. Coal layers two to eight feet thick come to the surface some miles off from the boundary, and it may with certainty be assumed that stone coal can be reached at a moderate depth near the deposits of iron ore of the permian period. If we cast a glance over the mineral kingdom of northwest Texas, and compare the same with that of England, we discover there the same appearances. In this respect Texas is equally favored, while its coal deposits in the earth, together with those of iron ore, embrace a space double that of England.—*Jacob Boll.*

GEOGRAPHY AND TRAVELS.[1]

THE ASCENT OF THE BINUÉ, IN AUGUST, 1879.—Of the few large rivers to be found on the African continent, the Niger and its tributary, the Binué, probably present fewer obstacles to navigation and afford the most uninterrupted means of access to the still unexplored equatorial region. The recent voyage, therefore, of the missionary steamer *Henry Venn*, which succeeded in reaching a point on the latter stream 140 miles further than has ever before been attained by boats is of much importance. We compile the following account of the trip from papers read before the Royal Geographical Society, by Mr. Edward Hutchinson,[2] and before the Berlin Society, by Herr Ed. Robert Flugel,[3] and also from statements furnished by the latter to *Petermann's Mittheilungen.*[4]

Mr. Hutchinson in his preliminary remarks upon the area drained by the rivers Binué and the Shary, discusses the much vexed problem of the identity of the Welle discovered by Schweinfurth, and which he and Keith Johnston believe to flow into the Shary, but which Stanley and Junker consider as belonging to the Congo system.

"The northern and eastern limits of the area drained by these two river systems are now fairly well ascertained. The travels of Petherick, Schewinfurth, Nachtigal, and Dr. Junker, have shown them to be, on the north-east, the ranges which run from the Tibesti mountains, and on the east the ranges which run through Darfur to Mount Baginze and west of the Albert Nyanza, the eastern slopes of which form the gathering grounds of the Bahr el Homr, the Bahr el Gazal, and the White Nile.

"The southern limits of the area we are considering, are as yet unknown. They will probably be found to be ranges of hills of no great elevation, running westwards

[1] Edited by ELLIS H. YARNALL, Philadelphia.

[2] *Proceedings of the Royal Geographical Society*, May, 1880, p. 289.

[3] *Verhandlungen der Gesellschaft für Erdkunde zu Berlin*, Band VII, No. 3, p. 112.

[4] *Petermann's Mittheilungen*, April, 1880, p. 146 with preface, by Dr. E. Behm, p. 145. See also number for June, 1880, for account of the voyage of the *Henry Venn* from the mouth of the Binué to Djen, also by Herr Flugel.

north of the Congo, and ultimately turning north and joining the range of the Cameroons mountains. These ranges or uplands form the northern and eastern watershed of the Congo, the Ogowé, and the Cross rivers.

"The watershed of the Ogowé has been crossed by the traveler De Brazza, at no great elevation, and Keith Johnston considers that the Ogowé gathers its large volume of waters from numerous tributaries, within a radius of a few hundred miles of the coast.

"The Cross river has been supposed to be a branch of the Niger, but it is more probable that, like the Gaboon river, it will be found to be only a large estuary receiving a number of small tributaries from adjacent uplands.

"It will thus be seen that the north-eastern and eastern limits, and possibly also the south-eastern, are mountain ranges of considerable height, and therefore play an important part as gathering grounds for rainfall, and, though we have no exact data as to rainfall, the mass of water which must fall upon them is enormous.

"The size of the Welle, as indicated by Schweinfurth, in its short course from its chief heads, shows the volume falling upon its highest gathering grounds. The drainage of the western slopes of the ranges, whose eastern sides supply the tributaries of the Bahr el Gazal, must furnish a volume equal to that stream—a volume which would be sufficient to account for the difference between the contents of the Welle, as given by Schweinfurth, and those of the Shary, as given by Major Denham, and to produce that vast body of water which floods the depression called the Bodele, crossed by Nachtigal in 1878, and finds a southern outfall in the direction I shall presently allude to.

"According to the testimony of Major Denham, who made his observations on the 24th of June, 1824, the width of the Shary at its mouth was about a half a mile, while its stream had a velocity of something under three miles an hour. This would indicate a stream three times as strong as that of the Welle, and if the average depth of the waters as they flow into Lake Chad be reckoned at ten feet, it would give a volume of 85,000 cubic feet a second, whereas at the very highest reckoning the volume of the Welle is not above 20,000 cubic feet.

"When Barth crossed the Shary in 1852, a much larger quantity of water was being discharged along its system. He crossed the Logon, a western branch or backwater, and further to the east he crossed the main branch at Mélé. The Logon was a large and powerful river, while the main stream contained more water at Mélé than Denham found at the mouth of the Shary.

"This difference in volume is accounted for by the variation in rainfall, 1851 and 1852 must have been seasons of heavy rainfall, for Barth also found a much greater depth of water in the Binué at Tæpe, than was found by our men last year. It is manifest, however, that the system of the river Shary accounts for the drainage of only a portion of this vast area.

"What outfall is there for the rainfall on the western slopes of the ranges to the north of the Congo and the Ogowé? I think it will be seen that the exploration of the Binué throws some light on this question and tends in the direction of the existence of a lake system somewhat similar to that of the Chad.

"The earliest maps of Africa suggest a large sheet of water in the southern half of the area we are considering. Felipe Pigafetta, on information furnished by Duarte Lopez, places it in two degrees north. It is somewhat remarkable that his is the only antique map of Africa which assigns to the Niger its true outlet, and although he falls into the common error of permitting two or three rivers to flow out of the same lake, yet the general features of his map are so near the truth as to suggest that the Portuguese had a fairly correct knowledge of the interior of Africa, but lacked the scientific methods of stating the information they possessed. Coming to later times, we have Piaggia, who places a great sheet of water in lat. 1° S. long. 24° E. It is true that he himself did not see the lake, but only gives the native report. There appears, however, to be no doubt that upon that meridian Piaggia has penetrated further south than any other European. Schweinfurth, moreover, speaks of him as an acute observer, and though his great lake depends on native report, it must not be forgotten that it was native information furnished to men hundreds of miles from the spot which led to the discovery of Tanganyika and the Victoria Nyanza.

"At the geographical council held by Mr. Stanley, at Kafurro, in Karagwe, there was a prevailing opinion that far to the north-west of the Mfumbiro mountains was a great lake to which no Arabs had ever penetrated. These Mfumbiro mountains are well to the south and on the west of the Albert Nyanza, and the direction thus

indicated points to the quarter in which Piaggia places his great lake. It is not impossible, therefore, that there may be in the southern part of the area we are considering, a system not unlike that of Lake Chad, and that consequently no considerable portion of the drainage from the southern hill ranges finds its way north."

The voyage of the *Henry Venn* was made under the direction of the English Church Missionary Society, their agent, Mr. J. H. Ashcroft, being in command. The vessel was built expressly for the navigation of the Niger. She is 120 feet long, 15 feet beam, 6 feet deep and draws 3 feet 6 inches of water on an even keel, with about 60 tons of cargo aboard. After being occupied for some time on the Lower Niger it was not until the flood season of last year that she undertook the ascent of the Binué, and sailed on that duty from Lukoja at the mouth of the river on July 8, 1879.

As far as Djen the river is well known from the previous expedition of 1854. This point was reached on the 20th of August. The river banks here are about six feet high, the river rather shallow. The people were friendly. A very picturesque range of mountains runs parallel with the river here, about two to three miles distant, inhabited, it is said by Herr Flugel, by cannibals. On the 22d they reached Gamadge, on the left bank, a mile or two below Mount Gabriel, to the west. Mount Gabriel is about five hundred feet high and is covered by very high grass in which the few bushes and trees standing on its sides are nearly hidden. The banks of the Binué are frequently higher than the adjacent country which sinks to the foot of the mountains, and is often swampy and covered by the waters in the time of floods.[1] The men came out in great force here armed with shields and spears, and bows and arrows. They salute here by holding up the right arm and putting the left on the stomach.

On arriving a few hours later at a small place called Iangai, they dispatched messengers to the King of Bassama, and on the 23d the King's son arrived with presents of a cow and a bullock. He seemed "a nice quiet sort of person," but the men who accompanied him were wild and fierce, and during the two days they remained here many threatening demonstrations were made. On the 25th they continued up the stream, passing several small towns. "The people did not seem to like the look of the steamer; it was more than they could understand all at once." "This part of the country is very thickly populated, and it would not take many visits to make very good friends of these people. The current is very rapid just above here; river varied in width; for the distance of 500 yards it narrows to about 250 yards wide, then opens out again to 500 or 600 yards; very few trees about here, only a few monkey-bread trees. Came in view of several new ranges of mountains, at a distance of from eight miles, the nearest,

[1] An interesting note on this characteristic feature of African Geography is given by Herr Flugel. *Petermann's Mittheilungen*, April, 1880, p. 148.

to twenty miles the most distant." On August the 26th, messengers arrived on horse-back from the King of Demsar. [Bassama?] They were dressed in fine scarlet cloth and brought a tusk of ivory. On the 27th they reached the first village of the Bulas.[1]

"I have not seen," Mr. Ashcroft remarks, "any part of Africa so thickly populated as this inhabited by the Bula people. For about twenty-five or thirty miles they are as thick as bees. In fact, since we left Djen, the country is very thickly peopled with fine, strong, warlike, healthy, robust people, that seem to lack nothing but a few more cloths; for they possess cattle, horses, and sheep in abundance, and are everywhere ready to repel invasion, fully armed with spear and shield, or poisoned arrow ready strung, and a quiver full ready for action. They put their hand over their mouths and put it quickly back again, making a shrill noise, 'bla, bla, blu, blu,' in quick succession; some saluted us by holding up the hand, but they never appeared to know what to do, we were so strange to them, coming right into the lion's den; for nothing seeks to pass these hostile Bula villages, nor do I think it possible for any but a good-sized steamer to be able to do this, for thousands of canoes came out during the time we took to pass all these villages. Some villages had 300 or 400 of these canoes, each holding three or four men standing up, with big long paddles, and armed with spears, which they are very expert in throwing, if we may go by what we saw them do when hunting a hippopotamus one day when anchored near while lying off Choma."

"A fine range of mountains on the left bank I called the Buxton mountains, but they are seen to much better advantage near Yola, and are nearer the water. From here they were about nine or ten miles off. Wright range on the right bank, is a splendid range, extending for a long distance, with peaks and terraces from 2000 to 2500 feet, with rugged perpendicular walls of red rock."

On the 28th, another fine range of mountains extending for a long distance along the right bank came in sight.

"Some of the peaks I should think nearly 3000 feet high, the usual height 1500 to 2000; this range extends many miles along, and in some places, near the right bank specially so, just abreast of Yola, with plenty of rock jutting out here and there, of sandstone, much worn. This is Barth's Mount Bagele in all probability." * * "The country which has been, since just above Djen, bare of trees, is now assuming a park-like appearance, with beautiful mountainous scenery on every side, and trees here and there, just like a park at home, and the hills rising from the water side; hitherto there has been more or less plain extending from the river to the foot of the mountains. An artist would have been blessed with the varied play of color, of rocks, trees and bushes, not to mention the rich vegetation, and the deep gullies and weather-worn rocks of many shades of color, some very rugged and bold." * * "Yola stands on rising ground, about three miles from the river, and is a long straggling place, composed of four lots of houses and compounds, *i.e.*, each house surrounded by a piece of cultivated ground, with a fence made of plaited grass, called by the natives, zenana."

Leaving the Bula territory they passed into a country inhabited by the Fulahs. This river grew broad and shallow; the banks swampy to the foot of the mountains, lying in broken ranges and reaching on the north side to from 1000 to 2000 feet in height. On September 2d, they passed with some difficulty, through a narrow channel over rapids, passing Tæpe, and arriving at the confluence of the Faro and Binué. The former appeared to be a shallow stream and was said to be full of rocks. The Binué above this point is much narrower, about two hundred yards wide;

[1] Herr Flugel thinks that about 12° 3′ E. long. on the northern bank, a large tributary, perhaps the Gongola, has its mouth, but he was not able to examine that portion of the shore.

the banks being overflowed at this period for a long distance inland. The Yarita or Blackstock mountain rises abruptly from the plain near here and appears to have been confounded by Dr. Barth with the Atlantika, which is stated by the natives to be a long distance south. The people on this part of the river were found to be friendly, quiet and industrious, and well clad.

The river has many bends, is very rocky, and frequently the navigation is very difficult and dangerous.

The *Henry Venn* reached her furthest point at Gurua, on September 4th, but the launch went eight or nine miles beyond to Ribago, about a mile from a range of mountains named by the party after Baroness Burdett Coutts. "Magnificent mountains, looking in the distance like a large palace with the center of the building higher than the rest. The finest scenery of the whole river was just about here. I was exceedingly sorry to have to turn back, the country being so beautiful; and the people treating us like old friends, not the least alarmed when we approached with the steamer."

The chief of Gurua told them that canoes could only be used during two or three months in the year. The Kebbi, one of the main branches of the Upper Binué was distant about two and a half days by land, and eight days distant the Binué "comes over mountains" in the Gunderi country. On the next day the river beginning to fill rapidly the *Henry Venn* started on her return down the river and reached Djen in three days, and Lukoja on September 27th.

Mr. Hutchinson in calling attention to the statement that the Binué above the junction with the Mayo Kebbi is a small stream and that therefore the Kebbi is the main branch, expresses the belief that the southern portion of Baghirmi is drained by that stream.

"It seems to rise not far from Tuburi, in a large sheet of water which is separated by a flat level of not more than twenty miles from the large ngâljam[1] of Demmo, which according to Barth, is in direct communication with the western branch of the Shary. Dr. Barth says he was persuaded that in less than fifty years European boats would keep up a regular annual intercourse between the great basin of the Chad and the Atlantic. An almost uninterrupted communication has been opened by nature herself, for, from the mouth of the Kwâra[2] to the confluence of the river Binué with the Mayo Kebbi, there is a natural passage, navigable without further obstruction for boats of about four feet in depth, and the Mayo Kebbi itself, in its present shallow state, seems to be navigable for canoes, or flat bottomed boats like those of the natives, which I have no doubt may, during the highest state of the inundation, go as far as Dâwa in the Tuburi country, where Dr. Vogel was struck with that large sheet of water, which to him seemed to be an independent central lake, but which is in reality nothing but a widening of the upper part of the Mayo Kebbi. It is very probable that from this place there may be some other shallow water course proceeding to join the large ngâljam of Demmo, so that there would exist a real bifurcation between the basin of the Niger and that of the Chad. But even if this should not be the case, the breadth of the water-parting between these two basins at

[1] Swamp.—Ed.

[2] The Niger.—Ed.

the utmost cannot exceed twenty miles, consisting of an entirely level flat, and probably of alluvial soil. The level of the Chad and that of the river Binué, near Gewé, where it is joined by the Mayo Kebbi, seems to be almost identical; at least according to all appearance, the Binué at the place mentioned, is not more than 850 or 900 feet above the level of the sea.

"The regular second rise in the Binué which overtook the *Henry Venn* on the 14th of September, would be explained by the draining of the waters through the Mayo Kebbi, caused by the highest rise in the Chad, which occurs in August. This, taken with the vast volume of the water which the rivers pour down, flooding the land fo· miles, seems to show its connection with a great system.

"Important results to the continent of Africa might follow an effort carefully made to rectify the apparent irregularities of the Shary. If only a portion of the enormous volume of water which is now absorbed and evaporated in the vast expanse of Lake Chad were turned into the Binué, through the Mayo Kebbi, not only would such steamers as the *Henry Venn* have access to that great lake, but they could probably ascend the Shary and Welle almost up to the territories of Munza, King of the Monbuttu."

Meteorological observations were taken on the *Henry Venn* four times during the day. There were no night records. Owing to the steadiness of the atmosphere, the daily variations of the barometer never amounting two-tenths of an inch when the vessel was at anchor, the approximate elevation of the highest point reached may be stated with some approach to accuracy at 624 feet above the level of the Niger at Lukoja.

This makes the average fall of the river to its mouth fifteen inches per mile.

The maximum of the thermometer was 91°, and the minimum 74°. The daily range amounted to only 3°. The average temperature for the whole period of eighty days was 79°. The thermometer did not rise to 80° in fifty-four days, and only reached 75° in nine days while the highest point was only attained once. Rain occurred on twenty-eight days and lightning on twenty-one days.

MICROSCOPY.[1]

HOLMAN'S NEW COMPRESSORIUM AND MOIST CHAMBER.[2]—In working with living animal forms suitable for the elucidation of some of the principal doctrines of life, any contrivance which will render the study easier, and hence more profitable and economical of time, should be hailed with delight by the working microscopist. Such a labor-saving device is represented in the accompanying cut, Fig. 1, of Mr. D. S. Holman's new compressor. This apparatus differs from all other compressors in being so arranged that the mica cover is fixed and immovable, while the lower, thicker plate of glass is moved up and down by means of a screw nut and spiral spring, an arrangement which enables the student to adjust the apparatus so as to apply *with certainty* any degree of pressure upon any soft object without risk of breaking large and expensive cover glasses, crushing the object unex-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

[2] Advance sheets from Journal Franklin Institute for August, 1880.

pectedly, or injuring high-power lenses. The writer by its means was enabled to study with great deliberation and certainty, the

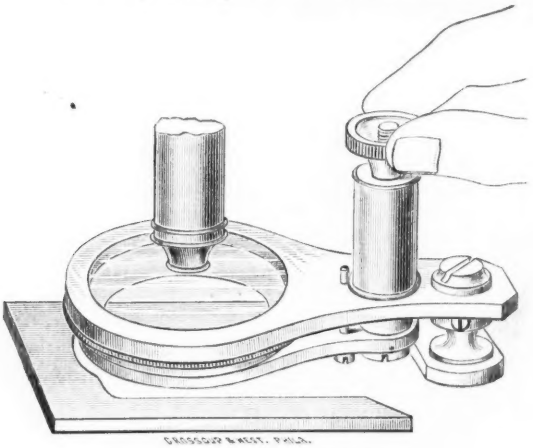

FIG. 1.

internal anatomy of the larva of the plumed crane-fly *(Corethra plumicornis)*. In this case the pressure could be so nicely adjusted as not to disturb in the slightest degree the normal physiological actions of the larval fly; the physiological action of the heart could be readily studied, as well as the significance of the so-called apolar ganglion cells of that organ. Every life process, in short, was visible through the transparent body of the creature, so that if *well* studied by the help of this apparatus, the student will have acquired a mental image or epitome of the morphology and physiology of that great group of jointed animals, the insects.

Equally good results were got by its use in studying the embryology of the shad, where it revealed to the writer, and for the

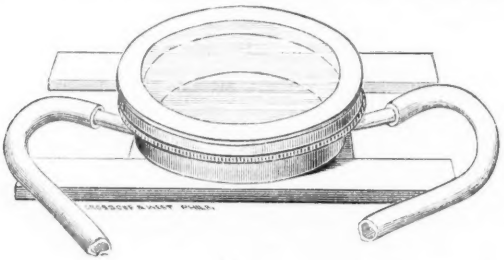

FIG. 2.

first time to science, the presence of a so-called polar vesicle in the earliest stages of development.

In Fig. 2 we have a combination of the familiar animalcule cage

and the siphon slide, also designed by Mr. Holman. The edge of the cover or cap is beveled, so that by rotating it against the inflow and outflow tubes of the siphon arrangement, a very convenient and effective compressor is obtained. The apparatus is equally as valuable as the compressor before described, because of the certainty with which one can gauge the amount of pressure which is applied; also on account of the facility with which water may be renewed in it when used as a "moist chamber" for studying growing fungi, without in the slightest degree disturbing these delicate plants. The value of the apparatus is further enhanced by the facility with which it may be used as a siphon slide for keeping aquatic larvæ, worms, etc., alive for a lengthened period for study or exhibition. It is equally useful as a dry compressor for holding, studying and drawing minute soft-bodied insects in the living state. These useful pieces of apparatus should be found upon the table of every working microscopist, where every day's use will demonstrate their indispensibility. It was in one of Mr. Holman's siphon slides, right under the microscope, that the writer successfully hatched young shad, a feat never before performed with the eggs of fishes.—*John A. Ryder.*

Methods of Dry Mounting.—Slides made of wood are lighter and stronger than glass ones, and look quite as elegant if made of ornamental wood and polished, or covered with fancy papers. In the first place procure some thin boards, about one-sixth or one-eighth part of an inch thick; these should be cut up into strips three inches long and one inch wide, and ground smooth with sand paper. In the center of these slips burn a hole to the required depth by means of a heated iron rod. I consider that this is a very good way of making a cell in the wood, as it leaves the surface black, and if the iron is carefully used it makes the bottom of the cell beautifully even. Into this cell drop a little thin liquid glue (which is made of shellac dissolved in methylated spirit), and with a small brush spread it all over the interior of the cell, and some little distance round the margin. This process has the very desirable effect of rendering the cell damp-proof. For small objects a circular piece of black or dark colored paper should be glued in the bottom of the cell, and the object (carefully dried) should be stuck in the center of the paper disc; if, however, the leaf with fungi has been cut sufficiently large to fill the bottom of the cell the paper circle may be dispensed with altogether. After another process of drying, the thin glass cover may be affixed by means of any of the various cements. * * * I venture to think that this method will be found to be equal, if not in some respects superior, to others in which the cell is built up on the slide, as there is no danger of the cell breaking off when roughly handled. * * * I believe wooden cells are often used for dry objects by many workers, but to those who have not yet given them

a trial, and especially to those who make a special study of that delightful branch of micro-botany, micro-fungi, I hope it will commend itself as a thoroughly efficient and simple method.—*George Clinch, in Science Gossip.*

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SCIENTIFIC NEWS.

— Died, in Beverly, Massachusetts, Count Louis François de Pourtales. Count Pourtales was born in Neufchatel, March 4, 1823. He belonged to the Swiss branch of an old family which has branches also in France, Prussia and Bohemia. He was educated as an engineer, and came to this country about the same time as Agassiz, and became his fellow-worker and pupil. Upon the death of Agassiz the Count was appointed Keeper of the Museum of Comparative Zoölogy, which position he held at the time of his death. He had previously entered the service of the Government in the Coast Survey. His papers on the physical geography of the Caribbean sea and the Gulf stream established his reputation in Europe as well as in America. Through the death of his father he succeeded to his title, and received a fortune which gave him the opportunity of devoting himself wholly to his favorite studies. It is said that his modesty amounted almost to a fault, and that people wondered why a man who was the master of three languages should speak so little. With intimate friends, however, he would converse freely, and never without giving information and amusement. The Count was of strong frame, and his temperate mode of life gave hope of a long period of usefulness. He was stricken with a painful malady, and, after several weeks of great suffering, which he heroically endured, he died. His old friend and preceptor, Prof. Louis Agassiz, died seven years ago.

— The two first parts of a new botanical work by Dr. Dodelport, of Zurich, have just been published by Herr Cæsar Schmidt, of that city. The title of the work is "Illustrirtes Pflanzenleben," and it promises to become one of unusual interest. In Part I the lower fungi are described in a popular manner. The author undertakes to popularize the results hitherto attained in our knowledge of putrefaction and contagion-fungi. He describes their forms, their size, and their manner of propagation; introduces the reader to their mode of life, and points out the danger arising to the human race from these minute organisms. The description is accompanied by two excellent plates, in one of which we recognize a reproduction on a small scale of a plate from the same author's famous "Atlas der Botanik für Hoch und Mittelschulen." Another chapter treats of miasma and contagions, and gives a

complete account of the present state of our knowledge of infection-fungi. Part II is devoted to carnivorous plants, and is even more generally interesting perhaps than the first. The work is profusely illustrated with the author's original drawings. Altogether it is sure to form a very welcome and valuable addition to botanical literature.—*Nature.*

— Some new experiments with regard to the influence of electricity on Bacteria have been published by Prof. Cohn, who adopted the method of sowing with Bacteria a sterilized mineral nutritive solution, subjecting them to electric currents, and noting the results. A Marie-Davy flask-element he finds to exert (according to strength of current) either no influence on the increase of Bacteria, or merely a retardative influence. On the other hand, the current from two powerful elements sterilized the nutritive solution completely at the positive pole in twelve to twenty-four hours, so that afterwards the Bacteria introduced did not increase. At the negative pole the action was weaker, the liquid not completely sterilized. At neither of the poles were the Bacteria killed, and when brought into another nutritive liquid they developed normally; on the other hand, yeast cells and mycelium fungus brought into the liquid that was sterile for Bacteria increased plentifully at the positive pole. A battery of five strong elements killed the Bacteria distributed in the liquid within twenty-four hours, and sterilized the liquid of both poles.—*English Mechanic.*

— The Eleventh Annual Report of the American Museum of Natural History in the Central Park, New York, states that the institution is now entirely out of debt, the members of the Board of Trustees having subscribed $27,250 to cover the indebtedness, which with the donations of other friends of the museum, leaves a small balance in the treasury. The city paid during the year, over $10,000 towards the maintenance of the museum. Valuable and costly additions in zoölogy, geology and anthropology have been made, while important additions have been made to the libraries deposited for safe keeping. Students from a number of institutions visit the libraries and collections; besides this efforts will be made to render the museum a direct benefit to the teachers and pupils of the public schools. We are glad to watch the development of this great and growing museum, and hope it will contribute still more decidedly to the advancement as well as the diffusion of science in New York, and be a means of rational enjoyment to the citizens.

— Mr. E Whymper is reported to have successfully accomplished the ascent of Chimborazo, the loftiest mountain in the Cordilleras of Ecuador. He took ten days in getting from the Rio Bamba two-thirds of the way up to the summit, and the

difficulties encountered were greater than was expected, owing to the wind and the rarefaction of the air. On the top of the mountain the thermometer showed a temperature of 11° Fahr. There is no crater at all, but two peaks, both of which Mr. Whymper ascended; he found that the higher one was at an elevation of 21,982 feet above the sea-level, or nearly 12,000 feet above the valley of Quito.—*English Mechanic.*

— The American Academy of Arts and Sciences celebrated the first centennial since its foundation in Boston, on the 26th of May. This is the oldest scientific society in America next to the American Philosophical Society of Philadelphia. The formal exercises were held at the Old South Church, where Franklin was baptized; addresses being made by Hon. R. C. Winthrop, Ex-president Asa Gray and others. At the collation in the rooms of the academy, numerous delegates from home and foreign societies expressed their congratulations and good wishes. A large attendance crowded the hall of the academy.

— Died on the 5th Aug., Alvah James Ibbotson, aged 53 years. Mr. Ibbotson was a lithographic artist who stood at the head of his profession in this country. Most of the best plates of vertebrate fossils published by Leidy and Cope were his work, besides many plates of the fossil invertebrata published by Meek, White and others. He was remarkable for accuracy and artistic finish, as well as rapidity of execution. Mr. Ibbotson was a native of England, and had been in the employ of T. Sinclair and Sons, of Philadelphia, for twenty-five years.

— A German naturalist, in the course of inquiries as to the phosphorescence of the sea, has found that the phenomenon occurs whenever sea fishes are brought into a three per cent. salt solution. The luminosity begins apparently in the eyes, spreads over the whole fish, and increases day by day. The fish after some time seems luminous throughout. The phosphorescent substance is a kind of mucus, which appears dirty-white by day, and shines in the dark.

— Mr. J. A. Lintner has received the appointment of State Entomologist, the office, discontinued after Dr. Fitch's death, having been again established. The appointment is a most fitting one, as Mr. Lintner is well known as an excellent observer and clear writer on economic entomology, besides having done a high order of work in general entomology.